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(54) Title: NOVEL HUMAN TRANSFERASE PROTEINS AND POLYNUCLEOTIDES ENCODING THE SAME

(57) Abstract: Novel human polynucleotide and polypeptide sequences are disclosed that can be used in therapeutic, diagnostic, and pharmacogenomic applications.

NOVEL HUMAN TRANSFERASE PROTEINS AND  
POLYNUCLEOTIDES ENCODING THE SAME

The present application claims the benefit of U.S.  
5 Provisional Application Numbers 60/185,920, which was filed on  
February 29, 2000, U.S. Provisional Application Number  
60/186,558 which was filed on March 2, 2000 and U.S.  
Provisional Application Number 60/191,849 which was filed on  
March 24, 2000. These U.S. Provisional Applications are herein  
10 incorporated by reference in their entirety.

## 1. INTRODUCTION

The present invention relates to the discovery,  
identification, and characterization of novel human  
polynucleotides encoding proteins that share sequence  
15 similarity with mammalian transferase proteins such as, but not  
limited to, sulfotransferases and N-acetyl-  
galactosaminyltransferases. The invention encompasses the  
described polynucleotides, host cell expression systems, the  
encoded proteins, fusion-proteins, polypeptides and peptides,  
20 antibodies to the encoded proteins and peptides, and  
genetically engineered animals that either lack or over express  
the disclosed polynucleotides, antagonists and agonists of the  
proteins, and other compounds that modulate the expression or  
activity of the proteins encoded by the disclosed  
25 polynucleotides that can be used for diagnosis, drug screening,  
clinical trial monitoring, and treatment of diseases and  
disorders.

## 2. BACKGROUND OF THE INVENTION

Transferases are biologically active proteins that covalently modify molecules such as biological substrates, including proteins, as part of degradation, maturation, and secretory pathways within the body. Transferases have thus been associated with, *inter alia*, development, immunity, cell replication, gene expression, cancer, protein and cellular senescence, hyperproliferative disorders and as cancer associated markers. In particular, transferases have been implicated in, *inter alia*, immune function and Parkinson's Disease.

## 3. SUMMARY OF THE INVENTION

The present invention relates to the discovery, identification, and characterization of nucleotides that encode novel human proteins, and the corresponding amino acid sequences of these proteins. The novel human proteins (NHPs) described for the first time herein share structural similarity with mammalian sulfotransferases, N-acetyl-galactosaminyltransferases and transferase proteins.

The novel human nucleic acid (cDNA) sequences described herein encode proteins/open reading frames (ORFs) of 303, 110, 265, 148, 148, 186, 59, 214, and 97 amino acids in length (sulfotransferases, SEQ ID NOS: 2, 4, 6, 8, 10, 12, 14, 16, and 18); 143, 224, 112, 269, 535, 506, 240, 321, 209, 366, 631, and 603 amino acids in length (N-galactosaminyltransferases, SEQ ID NOS: 21, 23, 25, 27, 29, 31, 33, 35, 37, 39, 41, and 43 respectively); and 184 amino acids in length (transferases, SEQ ID NO:46).

The invention also encompasses agonists and antagonists of the described NHPs, including small molecules, large molecules, mutant NHPs, or portions thereof, that compete with native NHP,

peptides, and antibodies, as well as nucleotide sequences that can be used to inhibit the expression of the described NHPs (e.g., antisense and ribozyme molecules, and gene or regulatory sequence replacement constructs) or to enhance the expression of the described NHP polynucleotides (e.g., expression constructs that place the described polynucleotide under the control of a strong promoter system), and transgenic animals that express a NHP transgene, or "knock-outs" (which can be conditional) that do not express a functional NHP. Knock-out mice can be produced in several ways, one of which involves the use of mouse embryonic stem cells ("ES cells") lines that contain gene trap mutations in a murine homolog of at least one of the described NHPs. When the unique NHP sequences described in SEQ ID NOS:1-47 are "knocked-out" they provide a method of identifying phenotypic expression of the particular gene as well as a method of assigning function to previously unknown genes. Additionally, the unique NHP sequences described in SEQ ID NOS:1-47 are useful for the identification of coding sequence and the mapping a unique gene to a particular chromosome.

Further, the present invention also relates to processes for identifying compounds that modulate, i.e., act as agonists or antagonists, of NHP expression and/or NHP activity that utilize purified preparations of the described NHPs and/or NHP product, or cells expressing the same. Such compounds can be used as therapeutic agents for the treatment of any of a wide variety of symptoms associated with biological disorders or imbalances.

#### 4. DESCRIPTION OF THE SEQUENCE LISTING AND FIGURES

The Sequence Listing provides the sequences of the described NHP ORFs that encode the described NHP amino acid

sequences. SEQ ID NOS: 19, 44, and 47 describe nucleotides encoding NHP ORFs along with regions of flanking sequence.

#### 5. DETAILED DESCRIPTION OF THE INVENTION

- 5       The NHPs described for the first time herein are novel proteins that may be expressed in, *inter alia*, human cell lines, human fetal brain, brain, pituitary, cerebellum, spinal cord, thymus, spleen, lymph node, bone marrow, trachea, kidney, fetal liver, liver, prostate, testis, thyroid, adrenal gland,
- 10   pancreas, salivary gland, stomach, small intestine, colon, skeletal muscle, heart, uterus, placenta, mammary gland, adipose, esophagus, bladder, cervix, rectum, pericardium, hypothalamus, ovary, fetal kidney, fetal lung, and gene trapped cells.
- 15   More particularly, the NHP that are similar to sulfotransferases is predominantly found in testis. The N-acetyl-galactosaminyltransferase-like NHP can be found expressed in the human fetal brain, brain, pituitary, cerebellum, spinal cord,
- 20   thymus, spleen, lymph node, bone marrow, trachea, kidney, fetal liver, liver, prostate, testis, thyroid, adrenal gland, pancreas, salivary gland, stomach, small intestine, colon, uterus, placenta, mammary gland, adipose, esophagus, bladder, cervix, rectum, pericardium, hypothalamus, ovary and fetal
- 25   lung. The NHP that is similar to transferase protein is expressed in human fetal brain, brain, pituitary, cerebellum, spinal cord, thymus, spleen, lymph node, bone marrow, trachea, kidney, fetal liver, liver, prostate, testis, thyroid, adrenal gland, pancreas, salivary gland, stomach, small intestine,
- 30   colon, skeletal muscle, uterus, mammary gland, adipose, skin, esophagus, cervix, rectum, pericardium, hypothalamus, ovary, fetal kidney and fetal lung.

The present invention encompasses the nucleotides presented in the Sequence Listing, host cells expressing such nucleotides, the expression products of such nucleotides, and:

(a) nucleotides that encode mammalian homologs of the described polynucleotides, including the specifically described NHPs, and the NHP products; (b) nucleotides that encode one or more portions of the NHPs that correspond to functional domains, and the polypeptide products specified by such nucleotide sequences, including but not limited to the novel regions of any active domain(s); (c) isolated nucleotides that encode mutant versions, engineered or naturally occurring, of the described NHPs in which all or a part of at least one domain is deleted or altered, and the polypeptide products specified by such nucleotide sequences, including but not limited to soluble proteins and peptides in which all or a portion of the signal (or hydrophobic transmembrane) sequence is deleted; (d) nucleotides that encode chimeric fusion proteins containing all or a portion of a coding region of an NHP, or one of its domains (e.g., a receptor or ligand binding domain, accessory protein/self-association domain, etc.) fused to another peptide or polypeptide; or (e) therapeutic or diagnostic derivatives of the described polynucleotides such as oligonucleotides, antisense polynucleotides, ribozymes, dsRNA, or gene therapy constructs comprising a sequence first disclosed in the Sequence Listing. As discussed above, the present invention includes: (a) the human DNA sequences presented in the Sequence Listing (and vectors comprising the same) and additionally contemplates any nucleotide sequence encoding a contiguous NHP open reading frame (ORF) that hybridizes to a complement of a DNA sequence presented in the Sequence Listing under highly stringent conditions, e.g., hybridization to filter-bound DNA in 0.5 M NaHPO<sub>4</sub>, 7% sodium dodecyl sulfate (SDS), 1 mM EDTA at 65°C, and washing in 0.1xSSC/0.1% SDS at 68°C (Ausubel F.M. et

al., eds., 1989, Current Protocols in Molecular Biology, Vol. I, Green Publishing Associates, Inc., and John Wiley & sons, Inc., New York, at p. 2.10.3) and encodes a functionally equivalent gene product. Additionally contemplated are any  
5 nucleotide sequences that hybridize to the complement of a DNA sequence that encodes and expresses an amino acid sequence presented in the Sequence Listing under moderately stringent conditions, e.g., washing in 0.2xSSC/0.1% SDS at 42°C (Ausubel et al., 1989, *supra*), yet still encodes a functionally  
10 equivalent NHP product. Functional equivalents of a NHP include naturally occurring NHPs present in other species and mutant NHPs whether naturally occurring or engineered (by site directed mutagenesis, gene shuffling, directed evolution as described in, for example, U.S. Patent No. 5,837,458). The  
15 invention also includes degenerate nucleic acid variants of the disclosed NHP polynucleotide sequences.

Additionally contemplated are polynucleotides encoding NHP ORFs, or their functional equivalents, encoded by  
~~polynucleotide sequences that are about 99, 95, 90, or about~~  
20 85 percent similar or identical to corresponding regions of the nucleotide sequences of the Sequence Listing (as measured by BLAST sequence comparison analysis using, for example, the GCG sequence analysis package using standard default settings).

The invention also includes nucleic acid molecules,  
25 preferably DNA molecules, that hybridize to, and are therefore the complements of, the described NHP nucleotide sequences. Such hybridization conditions may be highly stringent or less highly stringent, as described above. In instances where the nucleic acid molecules are deoxyoligonucleotides ("DNA  
30 oligos"), such molecules are generally about 16 to about 100 bases long, or about 20 to about 80, or about 34 to about 45 bases long, or any variation or combination of sizes represented therein that incorporate a contiguous region of

sequence first disclosed in the Sequence Listing. Such oligonucleotides can be used in conjunction with the polymerase chain reaction (PCR) to screen libraries, isolate clones, and prepare cloning and sequencing templates, etc.

5       Alternatively, such NHP oligonucleotides can be used as hybridization probes for screening libraries, and assessing gene expression patterns (particularly using a micro array or high-throughput "chip" format). Additionally, a series of the described NHP oligonucleotide sequences, or the complements  
10 thereof, can be used to represent all or a portion of the described NHP sequences. An oligonucleotide or polynucleotide sequence first disclosed in at least a portion of one or more of the sequences of SEQ ID NOS: 1-47 can be used as a hybridization probe in conjunction with a solid support  
15 matrix/substrate (resins, beads, membranes, plastics, polymers, metal or metallized substrates, crystalline or polycrystalline substrates, etc.). Of particular note are spatially addressable arrays (*i.e.*, gene chips, microtiter plates, etc.) of oligonucleotides and polynucleotides, or corresponding  
20 oligopeptides and polypeptides, wherein at least one of the biopolymers present on the spatially addressable array comprises an oligonucleotide or polynucleotide sequence first disclosed in at least one of the sequences of SEQ ID NOS: 1-47, or an amino acid sequence encoded thereby. Methods for  
25 attaching biopolymers to, or synthesizing biopolymers on, solid support matrices, and conducting binding studies thereon are disclosed in, *inter alia*, U.S. Patent Nos. 5,700,637, 5,556,752, 5,744,305, 4,631,211, 5,445,934, 5,252,743, 4,713,326, 5,424,186, and 4,689,405 the disclosures of which  
30 are herein incorporated by reference in their entirety.

Addressable arrays comprising sequences first disclosed in SEQ ID NOS:1-47 can be used to identify and characterize the temporal and tissue specific expression of a gene. These

addressable arrays incorporate oligonucleotide sequences of sufficient length to confer the required specificity, yet be within the limitations of the production technology. The length of these probes is within a range of between about 8 to  
5 about 2000 nucleotides. Preferably the probes consist of 60 nucleotides and more preferably 25 nucleotides from the sequences first disclosed in SEQ ID NOS:1-47.

For example, a series of the described oligonucleotide sequences, or the complements thereof, can be used in chip  
10 format to represent all or a portion of the described sequences. The oligonucleotides, typically between about 16 to about 40 (or any whole number within the stated range) nucleotides in length can partially overlap each other and/or the sequence may be represented using oligonucleotides that do  
15 not overlap. Accordingly, the described polynucleotide sequences shall typically comprise at least about two or three distinct oligonucleotide sequences of at least about 8 nucleotides in length that are each first disclosed in the described Sequence Listing. Such oligonucleotide sequences can  
20 begin at any nucleotide present within a sequence in the Sequence Listing and proceed in either a sense (5'-to-3') orientation vis-a-vis the described sequence or in an antisense orientation.

Microarray-based analysis allows the discovery of broad  
25 patterns of genetic activity, providing new understanding of gene functions and generating novel and unexpected insight into transcriptional processes and biological mechanisms. The use of addressable arrays comprising sequences first disclosed in SEQ ID NOS:1-47 provides detailed information about transcriptional  
30 changes involved in a specific pathway, potentially leading to the identification of novel components or gene functions that manifest themselves as novel phenotypes.

Probes consisting of sequences first disclosed in SEQ ID NOS:1-47 can also be used in the identification, selection and validation of novel molecular targets for drug discovery. The use of these unique sequences permits the direct confirmation of drug targets and recognition of drug dependent changes in gene expression that are modulated through pathways distinct from the drugs intended target. These unique sequences therefore also have utility in defining and monitoring both drug action and toxicity.

As an example of utility, the sequences first disclosed in SEQ ID NOS:1-47 can be utilized in microarrays or other assay formats, to screen collections of genetic material from patients who have a particular medical condition. These investigations can also be carried out using the sequences first disclosed in SEQ ID NOS:1-47 *in silico* and by comparing previously collected genetic databases and the disclosed sequences using computer software known to those in the art.

Thus the sequences first disclosed in SEQ ID NOS:1-47 can be used to identify mutations associated with a particular disease and also as a diagnostic or prognostic assay.

Although the presently described sequences have been specifically described using nucleotide sequence, it should be appreciated that each of the sequences can uniquely be described using any of a wide variety of additional structural attributes, or combinations thereof. For example, a given sequence can be described by the net composition of the nucleotides present within a given region of the sequence in conjunction with the presence of one or more specific oligonucleotide sequence(s) first disclosed in the SEQ ID NOS: 1-47. Alternatively, a restriction map specifying the relative positions of restriction endonuclease digestion sites, or various palindromic or other specific oligonucleotide sequences can be used to structurally describe a given sequence. Such

restriction maps, which are typically generated by widely available computer programs (e.g., the University of Wisconsin GCG sequence analysis package, SEQUENCHER 3.0, Gene Codes Corp., Ann Arbor, MI, etc.), can optionally be used in conjunction with one or more discrete nucleotide sequence(s) present in the sequence that can be described by the relative position of the sequence relative to one or more additional sequence(s) or one or more restriction sites present in the disclosed sequence.

- 10 For oligonucleotide probes, highly stringent conditions may refer, e.g., to washing in 6xSSC/0.05% sodium pyrophosphate at 37°C (for 14-base oligos), 48°C (for 17-base oligos), 55°C (for 20-base oligos), and 60°C (for 23-base oligos). These nucleic acid molecules may encode or act as NHP gene antisense molecules, useful, for example, in NHP gene regulation (for and/or as antisense primers in amplification reactions of NHP gene nucleic acid sequences). With respect to NHP gene regulation, such techniques can be used to regulate biological functions. Further, such sequences may be used as part of
- 20 ribozyme and/or triple helix sequences that are also useful for NHP gene regulation.

- Inhibitory antisense or double stranded oligonucleotides can additionally comprise at least one modified base moiety which is selected from the group including but not limited to
- 25 5-fluorouracil, 5-bromouracil, 5-chlorouracil, 5-iodouracil, hypoxanthine, xantine, 4-acetylcytosine, 5-(carboxyhydroxymethyl) uracil, 5-carboxymethylaminomethyl-2-thiouridine, 5-carboxymethylaminomethyluracil, dihydrouracil, beta-D-galactosylqueosine, inosine, N6-isopentenyladenine,
- 30 1-methylguanine, 1-methylinosine, 2,2-dimethylguanine, 2-methyladenine, 2-methylguanine, 3-methylcytosine, 5-methylcytosine, N6-adenine, 7-methylguanine, 5-methylaminomethyluracil, 5-methoxyaminomethyl-2-thiouracil,

beta-D-mannosylqueosine, 5'-methoxycarboxymethyluracil, 5-methoxyuracil, 2-methylthio-N6-isopentenyladenine, uracil-5-oxyacetic acid (v), wybutoxosine, pseudouracil, queosine, 2-thiocytosine, 5-methyl-2-thiouracil, 2-thiouracil, 5 4-thiouracil, 5-methyluracil, uracil-5-oxyacetic acid methylester, uracil-5-oxyacetic acid (v), 5-methyl-2-thiouracil, 3-(3-amino-3-N-2-carboxypropyl) uracil, (acp3)w, and 2,6-diaminopurine.

The antisense oligonucleotide can also comprise at least one modified sugar moiety selected from the group including but not limited to arabinose, 2-fluoroarabinose, xylulose, and hexose.

In yet another embodiment, the antisense oligonucleotide will comprise at least one modified phosphate backbone selected from the group consisting of a phosphorothioate, a phosphorodithioate, a phosphoramidothioate, a phosphoramidate, 15 a phosphordiamidate, a methylphosphonate, an alkyl phosphotriester, and a formacetal or analog thereof.

~~In yet another embodiment, the antisense oligonucleotide~~  
20 is an  $\alpha$ -anomeric oligonucleotide. An  $\alpha$ -anomeric oligonucleotide forms specific double-stranded hybrids with complementary RNA in which, contrary to the usual  $\beta$ -units, the strands run parallel to each other (Gautier et al., 1987, Nucl. Acids Res. 15:6625-6641). The oligonucleotide is a 2'-O-25 methylribonucleotide (Inoue et al., 1987, Nucl. Acids Res. 15:6131-6148), or a chimeric RNA-DNA analogue (Inoue et al., 1987, FEBS Lett. 215:327-330). Alternatively, double stranded RNA can be used to disrupt the expression and function of a targeted NHP.

30 Oligonucleotides of the invention can be synthesized by standard methods known in the art, e.g. by use of an automated DNA synthesizer (such as are commercially available from Biosearch, Applied Biosystems, etc.). As examples,

phosphorothioate oligonucleotides can be synthesized by the method of Stein et al. (1988, Nucl. Acids Res. 16:3209), and methylphosphonate oligonucleotides can be prepared by use of controlled pore glass polymer supports (Sarin et al., 1988, 5 Proc. Natl. Acad. Sci. U.S.A. 85:7448-7451), etc.

Low stringency conditions are well known to those of skill in the art, and will vary predictably depending on the specific organisms from which the library and the labeled sequences are derived. For guidance regarding such conditions see, for 10 example, Sambrook et al., 1989, Molecular Cloning, A Laboratory Manual (and periodic updates thereof), Cold Springs Harbor Press, N.Y.; and Ausubel et al., 1989, Current Protocols in Molecular Biology, Green Publishing Associates and Wiley Interscience, N.Y.

15 Alternatively, suitably labeled NHP nucleotide probes can be used to screen a human genomic library using appropriately stringent conditions or by PCR. The identification and characterization of human genomic clones is helpful for identifying polymorphisms (including, but not limited to, 20 nucleotide repeats, microsatellite alleles, single nucleotide polymorphisms, or coding single nucleotide polymorphisms), determining the genomic structure of a given locus/allele, and designing diagnostic tests. For example, sequences derived from regions adjacent to the intron/exon boundaries of the 25 human gene can be used to design primers for use in amplification assays to detect mutations within the exons, introns, splice sites (e.g., splice acceptor and/or donor sites), etc., that can be used in diagnostics and pharmacogenomics.

30 Further, a NHP gene homolog can be isolated from nucleic acid from an organism of interest by performing PCR using two degenerate or "wobble" oligonucleotide primer pools designed on the basis of amino acid sequences within the NHP products

disclosed herein. The template for the reaction may be total RNA, mRNA, and/or cDNA obtained by reverse transcription of mRNA prepared from human or non-human cell lines or tissue known or suspected to express an allele of a NHP gene.

5       The PCR product can be subcloned and sequenced to ensure that the amplified sequences represent the sequence of the desired NHP gene. The PCR fragment can then be used to isolate a full length cDNA clone by a variety of methods. For example, the amplified fragment can be labeled and used to screen a cDNA  
10 library, such as a bacteriophage cDNA library. Alternatively, the labeled fragment can be used to isolate genomic clones via the screening of a genomic library.

      PCR technology can also be used to isolate full length cDNA sequences. For example, RNA can be isolated, following  
15 standard procedures, from an appropriate cellular or tissue source (i.e., one known, or suspected, to express a NHP gene). A reverse transcription (RT) reaction can be performed on the RNA using an oligonucleotide primer specific for the most 5' end of the amplified fragment for the priming of first strand  
20 synthesis. The resulting RNA/DNA hybrid may then be "tailed" using a standard terminal transferase reaction, the hybrid may be digested with RNase H, and second strand synthesis may then be primed with a complementary primer. Thus, cDNA sequences upstream of the amplified fragment can be isolated. For a  
25 review of cloning strategies that can be used, see e.g., Sambrook et al., 1989, *supra*.

      A cDNA encoding a mutant NHP gene can be isolated, for example, by using PCR. In this case, the first cDNA strand may be synthesized by hybridizing an oligo-dT oligonucleotide to  
30 mRNA isolated from tissue known or suspected to be expressed in an individual putatively carrying a mutant NHP allele, and by extending the new strand with reverse transcriptase. The second strand of the cDNA is then synthesized using an

oligonucleotide that hybridizes specifically to the 5' end of the normal gene. Using these two primers, the product is then amplified via PCR, optionally cloned into a suitable vector, and subjected to DNA sequence analysis through methods well known to those of skill in the art. By comparing the DNA sequence of the mutant NHP allele to that of a corresponding normal NHP allele, the mutation(s) responsible for the loss or alteration of function of the mutant NHP gene product can be ascertained.

10 Alternatively, a genomic library can be constructed using DNA obtained from an individual suspected of or known to carry a mutant NHP allele (e.g., a person manifesting a NHP-associated phenotype such as, for example, obesity, high blood pressure, connective tissue disorders, infertility, etc.), or a  
15 cDNA library can be constructed using RNA from a tissue known, or suspected, to express a mutant NHP allele. A normal NHP gene, or any suitable fragment thereof, can then be labeled and used as a probe to identify the corresponding mutant NHP allele in such libraries. Clones containing mutant NHP gene sequences  
20 can then be purified and subjected to sequence analysis according to methods well known to those skilled in the art.

Additionally, an expression library can be constructed utilizing cDNA synthesized from, for example, RNA isolated from a tissue known, or suspected, to express a mutant NHP allele in  
25 an individual suspected of or known to carry such a mutant allele. In this manner, gene products made by the putatively mutant tissue can be expressed and screened using standard antibody screening techniques in conjunction with antibodies raised against a normal NHP product, as described below. (For  
30 screening techniques, see, for example, Harlow, E. and Lane, eds., 1988, "Antibodies: A Laboratory Manual", Cold Spring Harbor Press, Cold Spring Harbor, NY).

Additionally, screening can be accomplished by screening with labeled NHP fusion proteins, such as, for example, alkaline phosphatase-NHP or NHP-alkaline phosphatase fusion proteins. In cases where a NHP mutation results in an  
5 expressed gene product with altered function (e.g., as a result of a missense or a frameshift mutation), polyclonal antibodies to a NHP are likely to cross-react with a corresponding mutant NHP gene product. Library clones detected via their reaction with such labeled antibodies can be purified and subjected to  
10 sequence analysis according to methods well known in the art.

The invention also encompasses (a) DNA vectors that contain any of the foregoing NHP coding sequences and/or their complements (*i.e.*, antisense); (b) DNA expression vectors that contain any of the foregoing NHP coding sequences operatively  
15 associated with a regulatory element that directs the expression of the coding sequences (for example, baculo virus as described in U.S. Patent No. 5,869,336 herein incorporated by reference); (c) genetically engineered host cells that contain any of the foregoing NHP coding sequences operatively  
20 associated with a regulatory element that directs the expression of the coding sequences in the host cell; and (d) genetically engineered host cells that express an endogenous NHP gene under the control of an exogenously introduced regulatory element (*i.e.*, gene activation). As used herein,  
25 regulatory elements include, but are not limited to, inducible and non-inducible promoters, enhancers, operators and other elements known to those skilled in the art that drive and regulate expression. Such regulatory elements include but are not limited to the cytomegalovirus (hCMV) immediate early gene,  
30 regulatable, viral elements (particularly retroviral LTR promoters), the early or late promoters of SV40 adenovirus, the *lac* system, the *trp* system, the *TAC* system, the *TRC* system, the major operator and promoter regions of phage lambda, the

control regions of fd coat protein, the promoter for 3-phosphoglycerate kinase (PGK), the promoters of acid phosphatase, and the promoters of the yeast  $\alpha$ -mating factors.

The present invention also encompasses antibodies and  
5 anti-idiotypic antibodies (including Fab fragments),  
antagonists and agonists of the NHP, as well as compounds or  
nucleotide constructs that inhibit expression of a NHP gene  
(transcription factor inhibitors, antisense and ribozyme  
molecules, or gene or regulatory sequence replacement  
10 constructs), or promote the expression of a NHP (e.g.,  
expression constructs in which NHP coding sequences are  
operatively associated with expression control elements such as  
promoters, promoter/enhancers, etc.).

The NHPs or NHP peptides, NHP fusion proteins, NHP  
15 nucleotide sequences, antibodies, antagonists and agonists can  
be useful for the detection of mutant NHPs or inappropriately  
expressed NHPs for the diagnosis of disease. The NHP proteins  
or peptides, NHP fusion proteins, NHP nucleotide sequences,  
host cell expression systems, antibodies, antagonists, agonists  
20 and genetically engineered cells and animals can be used for  
screening for drugs (or high throughput screening of  
combinatorial libraries) effective in the treatment of the  
symptomatic or phenotypic manifestations of perturbing the  
normal function of NHP in the body. The use of engineered host  
25 cells and/or animals may offer an advantage in that such  
systems allow not only for the identification of compounds that  
bind to the endogenous receptor for an NHP, but can also  
identify compounds that trigger NHP-mediated activities or  
pathways.

30 Finally, the NHP products can be used as therapeutics.  
For example, soluble derivatives such as NHP peptides/domains  
corresponding to NHPs, NHP fusion protein products (especially  
NHP-Ig fusion proteins, i.e., fusions of a NHP, or a domain of

a NHP, to an IgFc), NHP antibodies and anti-idiotypic antibodies (including Fab fragments), antagonists or agonists (including compounds that modulate or act on downstream targets in a NHP-mediated pathway) can be used to directly treat  
5 diseases or disorders. For instance, the administration of an effective amount of soluble NHP, or a NHP-IgFc fusion protein or an anti-idiotypic antibody (or its Fab) that mimics the NHP could activate or effectively antagonize the endogenous NHP receptor. Nucleotide constructs encoding such NHP products can  
10 be used to genetically engineer host cells to express such products *in vivo*; these genetically engineered cells function as "bioreactors" in the body delivering a continuous supply of a NHP, a NHP peptide, or a NHP fusion protein to the body. Nucleotide constructs encoding functional NHPs, mutant NHPs, as  
15 well as antisense and ribozyme molecules can also be used in "gene therapy" approaches for the modulation of NHP expression. Thus, the invention also encompasses pharmaceutical formulations and methods for treating biological disorders.

Various aspects of the invention are described in greater  
20 detail in the subsections below.

### 5.1 THE NHP SEQUENCES

The cDNA sequences and the corresponding deduced amino acid sequences of the described NHPs are presented in the  
25 Sequence Listing. SEQ ID NOS:1-19 describe sequences that are similar to mammalian sulfotransferases which can be found expressed in human cell lines, gene trapped cells and human testes cells. SEQ ID NO:19 describes a NHP ORF as well as flanking regions. The NHP nucleotides were obtained from human  
30 cDNA libraries using probes and/or primers generated from human gene trapped sequence tags. Expression analysis has provided evidence that the described NHP can be expressed in human testes and gene trapped human cells.

SEQ ID NOS:20-44 describe sequences that are similar to mammalian N-acetyl-galactosaminyltransferases. SEQ ID NO:44 describes a NHP ORF as well as flanking regions. The NHP nucleotides were obtained from human cDNA libraries using  
5 probes and/or primers generated from human gene trapped sequence tags. Expression analysis has provided evidence that the described NHPs are widely expressed.

SEQ ID NOS:45-47 describe sequences that are similar to mammalian transferase proteins. SEQ ID NO:47 describes a NHP  
10 ORF as well as flanking regions. The NHP nucleotides were obtained by aligning human gene trapped sequence tags with cDNA sequences obtained from human adipose, cerebellum, fetal brain, and rectum RNA samples, and marathon ready cDNA purchased from Clontech (Palo Alto, CA). Expression analysis has provided  
15 evidence that the described NHPs are widely expressed.

## 5.2 NHPS AND NHP POLYPEPTIDES

NHPs, polypeptides, peptide fragments, mutated, truncated,  
20 or deleted forms of the NHPs, and/or NHP fusion proteins can be prepared for a variety of uses. These uses include but are not limited to the generation of antibodies, as reagents in diagnostic assays, the identification of other cellular gene products related to a NHP, as reagents in assays for screening  
25 for compounds that can be as pharmaceutical reagents useful in the therapeutic treatment of mental, biological, or medical disorders and diseases. Given the similarity information and expression data, the described NHPs can be targeted (by drugs, oligos, antibodies, etc,) in order to treat disease, or to  
30 therapeutically augment the efficacy of, for example, chemotherapeutic agents used in the treatment of breast or prostate cancer.

The Sequence Listing discloses the amino acid sequences encoded by the described NHP polynucleotides. The NHPs typically display have initiator methionines in DNA sequence contexts consistent with a translation initiation site.

5       The NHP amino acid sequences of the invention include the amino acid sequence presented in the Sequence Listing as well as analogues and derivatives thereof. Further, corresponding NHP homologues from other species are encompassed by the invention. In fact, any NHP protein encoded by the NHP  
10   nucleotide sequences described above are within the scope of the invention, as are any novel polynucleotide sequences encoding all or any novel portion of an amino acid sequence presented in the Sequence Listing. The degenerate nature of the genetic code is well known, and, accordingly, each amino  
15   acid presented in the Sequence Listing, is generically representative of the well known nucleic acid "triplet" codon, or in many cases codons, that can encode the amino acid. As such, as contemplated herein, the amino acid sequences presented in the Sequence Listing, when taken together with the  
20   genetic code (see, for example, Table 4-1 at page 109 of "Molecular Cell Biology", 1986, J. Darnell et al. eds., Scientific American Books, New York, NY, herein incorporated by reference) are generically representative of all the various permutations and combinations of nucleic acid sequences that  
25   can encode such amino acid sequences.

      The invention also encompasses proteins that are functionally equivalent to the NHPs encoded by the presently described nucleotide sequences as judged by any of a number of criteria, including, but not limited to, the ability to bind  
30   and cleave a substrate of a NHP, or the ability to effect an identical or complementary downstream pathway, or a change in cellular metabolism (e.g., proteolytic activity, ion flux, tyrosine phosphorylation, etc.). Such functionally equivalent

NHP proteins include, but are not limited to, additions or substitutions of amino acid residues within the amino acid sequence encoded by the NHP nucleotide sequences described above, but which result in a silent change, thus producing a functionally equivalent gene product. Amino acid substitutions may be made on the basis of similarity in polarity, charge, solubility, hydrophobicity, hydrophilicity, and/or the amphipathic nature of the residues involved. For example, nonpolar (hydrophobic) amino acids include alanine, leucine, isoleucine, valine, proline, phenylalanine, tryptophan, and methionine; polar neutral amino acids include glycine, serine, threonine, cysteine, tyrosine, asparagine, and glutamine; positively charged (basic) amino acids include arginine, lysine, and histidine; and negatively charged (acidic) amino acids include aspartic acid and glutamic acid.

A variety of host-expression vector systems can be used to express the NHP nucleotide sequences of the invention. Where, as in the present instance, the NHP peptide or polypeptide is thought to be membrane protein, the hydrophobic regions of the protein can be excised and the resulting soluble peptide or polypeptide can be recovered from the culture media. Such expression systems also encompass engineered host cells that express a NHP, or functional equivalent, *in situ*. Purification or enrichment of a NHP from such expression systems can be accomplished using appropriate detergents and lipid micelles and methods well known to those skilled in the art. However, such engineered host cells themselves may be used in situations where it is important not only to retain the structural and functional characteristics of the NHP, but to assess biological activity, e.g., in drug screening assays.

The expression systems that may be used for purposes of the invention include but are not limited to microorganisms such as bacteria (e.g., *E. coli*, *B. subtilis*) transformed with

recombinant bacteriophage DNA, plasmid DNA or cosmid DNA  
expression vectors containing NHP nucleotide sequences; yeast  
(e.g., *Saccharomyces*, *Pichia*) transformed with recombinant  
yeast expression vectors containing NHP nucleotide sequences;  
5 insect cell systems infected with recombinant virus expression  
vectors (e.g., baculovirus) containing NHP sequences; plant  
cell systems infected with recombinant virus expression vectors  
(e.g., cauliflower mosaic virus, CaMV; tobacco mosaic virus,  
TMV) or transformed with recombinant plasmid expression vectors  
10 (e.g., Ti plasmid) containing NHP nucleotide sequences; or  
mammalian cell systems (e.g., COS, CHO, BHK, 293, 3T3)  
harboring recombinant expression constructs containing  
promoters derived from the genome of mammalian cells (e.g.,  
metallothionein promoter) or from mammalian viruses (e.g., the  
15 adenovirus late promoter; the vaccinia virus 7.5K promoter).

In bacterial systems, a number of expression vectors may  
be advantageously selected depending upon the use intended for  
the NHP product being expressed. For example, when a large  
quantity of such a protein is to be produced for the generation  
20 of pharmaceutical compositions of or containing NHP, or for  
raising antibodies to a NHP, vectors that direct the expression  
of high levels of fusion protein products that are readily  
purified may be desirable. Such vectors include, but are not  
limited, to the *E. coli* expression vector pUR278 (Ruther et  
25 al., 1983, EMBO J. 2:1791), in which a NHP coding sequence may  
be ligated individually into the vector in frame with the *lacZ*  
coding region so that a fusion protein is produced; pIN vectors  
(Inouye & Inouye, 1985, Nucleic Acids Res. 13:3101-3109; Van  
Heeke & Schuster, 1989, J. Biol. Chem. 264:5503-5509); and the  
30 like. pGEX vectors (Pharmacia or American Type Culture  
Collection) can also be used to express foreign polypeptides as  
fusion proteins with glutathione S-transferase (GST). In

general, such fusion proteins are soluble and can easily be purified from lysed cells by adsorption to glutathione-agarose beads followed by elution in the presence of free glutathione. The PGEX vectors are designed to include thrombin or factor Xa  
5 protease cleavage sites so that the cloned target gene product can be released from the GST moiety.

In an insect system, *Autographa californica* nuclear polyhydrosis virus (AcNPV) is used as a vector to express foreign genes. The virus grows in *Spodoptera frugiperda* cells.  
10 A NHP coding sequence may be cloned individually into non-essential regions (for example the polyhedrin gene) of the virus and placed under control of an AcNPV promoter (for example the polyhedrin promoter). Successful insertion of NHP coding sequence will result in inactivation of the polyhedrin  
15 gene and production of non-occluded recombinant virus (i.e., virus lacking the proteinaceous coat coded for by the polyhedrin gene). These recombinant viruses are then used to infect *Spodoptera frugiperda* cells in which the inserted sequence is expressed (e.g., see Smith et al., 1983, J. Virol.  
20 46:584; Smith, U.S. Patent No. 4,215,051).

In mammalian host cells, a number of viral-based expression systems may be utilized. In cases where an adenovirus is used as an expression vector, the NHP nucleotide sequence of interest may be ligated to an adenovirus  
25 transcription/translation control complex, e.g., the late promoter and tripartite leader sequence. This chimeric gene may then be inserted in the adenovirus genome by *in vitro* or *in vivo* recombination. Insertion in a non-essential region of the viral genome (e.g., region E1 or E3) will result in a  
30 recombinant virus that is viable and capable of expressing a NHP product in infected hosts (e.g., See Logan & Shenk, 1984, Proc. Natl. Acad. Sci. USA 81:3655-3659). Specific initiation

signals may also be required for efficient translation of inserted NHP nucleotide sequences. These signals include the ATG initiation codon and adjacent sequences. In cases where an entire NHP gene or cDNA, including its own initiation codon and adjacent sequences, is inserted into the appropriate expression vector, no additional translational control signals may be needed. However, in cases where only a portion of a NHP coding sequence is inserted, exogenous translational control signals, including, perhaps, the ATG initiation codon, must be provided. Furthermore, the initiation codon must be in phase with the reading frame of the desired coding sequence to ensure translation of the entire insert. These exogenous translational control signals and initiation codons can be of a variety of origins, both natural and synthetic. The efficiency of expression may be enhanced by the inclusion of appropriate transcription enhancer elements, transcription terminators, etc. (See Bittner et al., 1987, Methods in Enzymol. 153:516-544).

~~In addition, a host cell strain may be chosen that~~

modulates the expression of the inserted sequences, or modifies and processes the gene product in the specific fashion desired. Such modifications (e.g., glycosylation) and processing (e.g., cleavage) of protein products may be important for the function of the protein. Different host cells have characteristic and specific mechanisms for the post-translational processing and modification of proteins and gene products. Appropriate cell lines or host systems can be chosen to ensure the correct modification and processing of the foreign protein expressed. To this end, eukaryotic host cells which possess the cellular machinery for proper processing of the primary transcript, glycosylation, and phosphorylation of the gene product may be used. Such mammalian host cells include, but are not limited

to, CHO, VERO, BHK, HeLa, COS, MDCK, 293, 3T3, WI38, and in particular, human cell lines.

For long-term, high-yield production of recombinant proteins, stable expression is preferred. For example, cell  
5 lines which stably express the NHP sequences described above can be engineered. Rather than using expression vectors which contain viral origins of replication, host cells can be transformed with DNA controlled by appropriate expression control elements (e.g., promoter, enhancer sequences,  
10 transcription terminators, polyadenylation sites, etc.), and a selectable marker. Following the introduction of the foreign DNA, engineered cells may be allowed to grow for 1-2 days in an enriched media, and then are switched to a selective media. The selectable marker in the recombinant plasmid confers  
15 resistance to the selection and allows cells to stably integrate the plasmid into their chromosomes and grow to form foci which in turn can be cloned and expanded into cell lines. This method may advantageously be used to engineer cell lines which express the NHP product. Such engineered cell lines may  
20 be particularly useful in screening and evaluation of compounds that affect the endogenous activity of the NHP product.

A number of selection systems may be used, including but not limited to the herpes simplex virus thymidine kinase (Wigler, et al., 1977, Cell 11:223), hypoxanthine-guanine  
25 phosphoribosyltransferase (Szybalska & Szybalski, 1962, Proc. Natl. Acad. Sci. USA 48:2026), and adenine phosphoribosyltransferase (Lowy, et al., 1980, Cell 22:817) genes can be employed in tk<sup>-</sup>, hgp<sup>-</sup> or ap<sup>-</sup> cells, respectively. Also, antimetabolite resistance can be used as  
30 the basis of selection for the following genes: dhfr, which confers resistance to methotrexate (Wigler, et al., 1980, Natl. Acad. Sci. USA 77:3567; O'Hare, et al., 1981, Proc. Natl. Acad. Sci. USA 78:1527); gpt, which confers resistance to

mycophenolic acid (Mulligan & Berg, 1981, Proc. Natl. Acad. Sci. USA 78:2072); neo, which confers resistance to the aminoglycoside G-418 (Colberre-Garapin, et al., 1981, J. Mol. Biol. 150:1); and hygromycin (Santerre, et al., 1984, Gene 30:147).

Alternatively, any fusion protein can be readily purified by utilizing an antibody specific for the fusion protein being expressed. For example, a system described by Janknecht et al. allows for the ready purification of non-denatured fusion proteins expressed in human cell lines (Janknecht, et al., 1991, Proc. Natl. Acad. Sci. USA 88:8972-8976). In this system, the gene of interest is subcloned into a vaccinia recombination plasmid such that the gene's open reading frame is translationally fused to an amino-terminal tag consisting of six histidine residues. Extracts from cells infected with recombinant vaccinia virus are loaded onto Ni<sup>2+</sup>-nitriloacetic acid-agarose columns and histidine-tagged proteins are selectively eluted with imidazole-containing buffers.

Also encompassed by the present invention are fusion proteins that direct the NHP to a target organ and/or facilitate transport across the membrane into the cytosol. Conjugation of NHPs to antibody molecules or their Fab fragments could be used to target cells bearing a particular epitope. Attaching the appropriate signal sequence to the NHP would also transport the NHP to the desired location within the cell. Alternatively targeting of NHP or its nucleic acid sequence might be achieved using liposome or lipid complex based delivery systems. Such technologies are described in Liposomes: A Practical Approach, New, RRC ed., Oxford University Press, New York and in U.S. Patents Nos. 4,594,595, 5,459,127, 5,948,767 and 6,110,490 and their respective disclosures which are herein incorporated by reference in their entirety. Additionally embodied are novel protein constructs engineered

in such a way that they facilitate transport of the NHP to the target site or desired organ. This goal may be achieved by coupling of the NHP to a cytokine or other ligand that provides targeting specificity, and/or to a protein transducing domain  
5 (see generally U.S. applications Ser. No. 60/111,701 and 60/056,713, both of which are herein incorporated by reference, for examples of such transducing sequences) to facilitate passage across cellular membranes if needed and can optionally be engineered to include nuclear localization sequences when  
10 desired.

### 5.3 ANTIBODIES TO NHP PRODUCTS

Antibodies that specifically recognize one or more epitopes of a NHP, or epitopes of conserved variants of a NHP,  
15 or peptide fragments of a NHP are also encompassed by the invention. Such antibodies include but are not limited to polyclonal antibodies, monoclonal antibodies (mAbs), humanized or chimeric antibodies, single chain antibodies, Fab fragments, F(ab')<sub>2</sub> fragments, fragments produced by a Fab expression  
20 library, anti-idiotypic (anti-Id) antibodies, and epitope-binding fragments of any of the above.

The antibodies of the invention may be used, for example, in the detection of NHP in a biological sample and may, therefore, be utilized as part of a diagnostic or prognostic  
25 technique whereby patients may be tested for abnormal amounts of NHP. Such antibodies may also be utilized in conjunction with, for example, compound screening schemes for the evaluation of the effect of test compounds on expression and/or activity of a NHP gene product. Additionally, such antibodies  
30 can be used in conjunction gene therapy to, for example, evaluate the normal and/or engineered NHP-expressing cells prior to their introduction into the patient. Such antibodies may additionally be used as a method for the inhibition of

abnormal NHP activity. Thus, such antibodies may, therefore, be utilized as part of treatment methods.

For the production of antibodies, various host animals may be immunized by injection with a NHP, an NHP peptide (e.g., one  
5 corresponding to a functional domain of an NHP), truncated NHP polypeptides (NHP in which one or more domains have been deleted), functional equivalents of the NHP or mutated variant of the NHP. Such host animals may include but are not limited to pigs, rabbits, mice, goats, and rats, to name but a few.  
10 Various adjuvants may be used to increase the immunological response, depending on the host species, including but not limited to Freund's adjuvant (complete and incomplete), mineral salts such as aluminum hydroxide or aluminum phosphate, surface active substances such as lysolecithin, pluronic polyols,  
15 polyanions, peptides, oil emulsions, and potentially useful human adjuvants such as BCG (bacille Calmette-Guerin) and *Corynebacterium parvum*. Alternatively, the immune response could be enhanced by combination and or coupling with molecules such as keyhole limpet hemocyanin, tetanus toxoid, diphtheria  
20 toxoid, ovalbumin, cholera toxin or fragments thereof. Polyclonal antibodies are heterogeneous populations of antibody molecules derived from the sera of the immunized animals.

Monoclonal antibodies, which are homogeneous populations of antibodies to a particular antigen, can be obtained by any  
25 technique which provides for the production of antibody molecules by continuous cell lines in culture. These include, but are not limited to, the hybridoma technique of Kohler and Milstein, (1975, Nature 256:495-497; and U.S. Patent No. 4,376,110), the human B-cell hybridoma technique (Kosbor et  
30 al., 1983, Immunology Today 4:72; Cole et al., 1983, Proc. Natl. Acad. Sci. USA 80:2026-2030), and the EBV-hybridoma technique (Cole et al., 1985, Monoclonal Antibodies And Cancer Therapy, Alan R. Liss, Inc., pp. 77-96). Such antibodies may

be of any immunoglobulin class including IgG, IgM, IgE, IgA, IgD and any subclass thereof. The hybridoma producing the mAb of this invention may be cultivated *in vitro* or *in vivo*.

Production of high titers of mAbs *in vivo* makes this the  
5 presently preferred method of production.

In addition, techniques developed for the production of "chimeric antibodies" (Morrison *et al.*, 1984, Proc. Natl. Acad. Sci., 81:6851-6855; Neuberger *et al.*, 1984, Nature, 312:604-608; Takeda *et al.*, 1985, Nature, 314:452-454) by splicing the  
10 genes from a mouse antibody molecule of appropriate antigen specificity together with genes from a human antibody molecule of appropriate biological activity can be used. A chimeric antibody is a molecule in which different portions are derived from different animal species, such as those having a variable  
15 region derived from a murine mAb and a human immunoglobulin constant region. Such technologies are described in U.S. Patents Nos. 6,075,181 and 5,877,397 and their respective disclosures which are herein incorporated by reference in their entirety. Also encompassed by the present invention is the use  
20 of fully humanized monoclonal antibodies as described in US Patent No. 6,150,584 and respective disclosures which are herein incorporated by reference in their entirety.

Alternatively, techniques described for the production of single chain antibodies (U.S. Patent 4,946,778; Bird, 1988,  
25 Science 242:423-426; Huston *et al.*, 1988, Proc. Natl. Acad. Sci. USA 85:5879-5883; and Ward *et al.*, 1989, Nature 334:544-546) can be adapted to produce single chain antibodies against NHP gene products. Single chain antibodies are formed by linking the heavy and light chain fragments of the Fv region  
30 via an amino acid bridge, resulting in a single chain polypeptide.

Antibody fragments which recognize specific epitopes may be generated by known techniques. For example, such fragments

include, but are not limited to: the F(ab')<sub>2</sub> fragments which can be produced by pepsin digestion of the antibody molecule and the Fab fragments which can be generated by reducing the disulfide bridges of the F(ab')<sub>2</sub> fragments. Alternatively, Fab  
5 expression libraries may be constructed (Huse et al., 1989, Science, 246:1275-1281) to allow rapid and easy identification of monoclonal Fab fragments with the desired specificity.

Antibodies to a NHP can, in turn, be utilized to generate anti-idiotypic antibodies that "mimic" a given NHP, using  
10 techniques well known to those skilled in the art. (See, e.g., Greenspan & Bona, 1993, FASEB J 7(5):437-444; and Nissinoff, 1991, J. Immunol. 147(8):2429-2438). For example antibodies which bind to a NHP domain and competitively inhibit the binding of NHP to its cognate receptor can be used to generate  
15 anti-idiotypes that "mimic" the NHP and, therefore, bind and activate or neutralize a receptor. Such anti-idiotypic antibodies or Fab fragments of such anti-idiotypes can be used in therapeutic regimens involving a NHP mediated pathway.

---

The present invention is not to be limited in scope by the  
20 specific embodiments described herein, which are intended as single illustrations of individual aspects of the invention, and functionally equivalent methods and components are within the scope of the invention. Indeed, various modifications of the invention, in addition to those shown and described herein  
25 will become apparent to those skilled in the art from the foregoing description. Such modifications are intended to fall within the scope of the appended claims. All cited publications, patents, and patent applications are herein incorporated by reference in their entirety.

WHAT IS CLAIMED IS:

1. An isolated nucleic acid molecule comprising at least 24 contiguous bases of nucleotide sequence first  
5 disclosed in SEQ ID NO: 1.

2. An isolated nucleic acid molecule comprising a nucleotide sequence that:

- 10 (a) encodes the amino acid sequence shown in SEQ ID NO: 2; and  
(b) hybridizes under stringent conditions to the nucleotide sequence of SEQ ID NO:1 or the complement thereof.

15 3. An isolated nucleic acid molecule comprising a nucleotide sequence that encodes the amino acid sequence shown in SEQ ID NO:2.

---

20 ~~4. An isolated nucleic acid molecule comprising at~~  
least 24 contiguous bases of nucleotide sequence first disclosed in SEQ ID NO: 42.

5. An isolated nucleic acid molecule comprising a nucleotide sequence that:

- 25 (a) encodes the amino acid sequence shown in SEQ ID NO:43; and  
(b) hybridizes under stringent conditions to the nucleotide sequence of SEQ ID NO:42 or the complement thereof.

30

4. An isolated nucleic acid molecule comprising a nucleotide sequence that encodes the amino acid sequence shown in SEQ ID NO:43.

5. An isolated oligopeptide comprising at least about 12 amino acids in a sequence first disclosed in SEQ ID NO:43.
- 5 6. An isolated nucleic acid molecule encoding the amino acid sequence described in SEQ ID NO:41.
7. An isolated nucleic acid molecule encoding the amino acid sequence described in SEQ ID NO:29.
- 10 8. An isolated nucleic acid molecule encoding the amino acid sequence described in SEQ ID NO:31.
9. An isolated nucleic acid molecule comprising at least 24 contiguous bases of nucleotide sequence first disclosed in SEQ ID NO: 45.
- 15 10. An isolated nucleic acid molecule comprising a nucleotide sequence that:
- 
- 20 (a) encodes the amino acid sequence shown in SEQ ID NO: 46; and
- (b) hybridizes under stringent conditions to the nucleotide sequence of SEQ ID NO:45 or the complement thereof.
- 25 11. An isolated nucleic acid molecule comprising a nucleotide sequence that encodes the amino acid sequence shown in SEQ ID NO:46.

## SEQUENCE LISTING

&lt;110&gt; LEXICON GENETICS INCORPORATED

<120> NOVEL HUMAN TRANSFERASE PROTEINS AND  
POLYNUCLEOTIDES ENCODING THE SAME

&lt;130&gt; LEX-0144-PCT

&lt;150&gt; US 60/185,920

&lt;151&gt; 2000-02-29

&lt;150&gt; US 60/186,558

&lt;151&gt; 2000-03-02

&lt;150&gt; US 60/191,849

&lt;151&gt; 2000-03-24

&lt;160&gt; 47

&lt;170&gt; FastSEQ for Windows Version 4.0

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Ile Leu His Ile Val Ser Glu Leu Ile Tyr Ala Val Ser Lys Lys Lys
      35             40             45
Tyr Lys Tyr Pro Glu Phe Pro Val Leu Glu Cys Gly Asp Ser Glu Lys
      50             55             60
Tyr Gln Arg Met Lys Gly Phe Pro Ser Pro Arg Ile Leu Ala Thr His
65             70             75             80
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      35             40             45
Tyr Lys Tyr Pro Glu Phe Pro Val Leu Glu Cys Gly Asp Ser Glu Lys
      50             55             60
Tyr Gln Arg Met Lys Gly Phe Pro Ser Pro Arg Ile Leu Ala Thr His
65             70             75             80
Leu His Tyr Asp Lys Leu Pro Gly Ser Ile Phe Glu Asn Lys Ala Lys
      85             90             95
Ile Leu Val Ile Phe Arg Asn Pro Lys Asp Thr Ala Val Ser Phe Leu

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      130      135      140
Phe Asp Phe Ala Ile Asn Trp Asn Lys His Leu Asp Gly Asp Asn Val
145      150      155      160
Lys Phe Ile Leu Tyr Glu Asp Leu Lys Glu Asn Leu Ala Ala Gly Ile
      165      170      175
Lys Gln Ile Ala Glu Phe Leu Gly Phe Phe Leu Thr Gly Glu Gln Ile
      180      185      190
Gln Thr Ile Ser Val Gln Ser Thr Phe Gln Ala Met Arg Ala Lys Ser
      195      200      205
Gln Asp Thr His Gly Ala Val Gly Pro Phe Leu Phe Arg Lys Gly Glu
      210      215      220
Val Gly Asp Trp Lys Asn Leu Phe Ser Glu Ile Gln Asn Gln Glu Met
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gtgctagcat cttatcaaaa gtgcggttca aactggattc tccacattgt cagtgaatta 120
atatatgctg tttctaaaaa aaagtataaa tatccagaat tcccagttct tgaatgtggg 180
gattcagaaa aatatcagag aatgaaagc tttccatcac caaggatttt ggcaactcac 240
ctccactatg acaaattacc tgggtctatc ttcgagaata aagccaagat attggtgata 300
tttcgaaacc ctaaagatac agcagtatct tttttgcatt tccacaacga tgtccccgat 360
attccaagct atggctcttg ggatgaattc ttcagacagt tcatgaaagg acaagaatct 420
ggctgctgga ataaaacaga ttgctga 447

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<210> 8  
 <211> 148  
 <212> PRT  
 <213> homo sapiens

```

<400> 8
Met Cys Thr Ser Glu Thr Phe Gln Ala Leu Asp Thr Phe Glu Ala Arg
 1      5      10      15
His Asp Asp Ile Val Leu Ala Ser Tyr Pro Lys Cys Gly Ser Asn Trp
      20      25      30
Ile Leu His Ile Val Ser Glu Leu Ile Tyr Ala Val Ser Lys Lys Lys
      35      40      45
Tyr Lys Tyr Pro Glu Phe Pro Val Leu Glu Cys Gly Asp Ser Glu Lys
      50      55      60
Tyr Gln Arg Met Lys Gly Phe Pro Ser Pro Arg Ile Leu Ala Thr His
      65      70      75      80
Leu His Tyr Asp Lys Leu Pro Gly Ser Ile Phe Glu Asn Lys Ala Lys
      85      90      95

```

Ile Leu Val Ile Phe Arg Asn Pro Lys Asp Thr Ala Val Ser Phe Leu  
 100 105 110  
 His Phe His Asn Asp Val Pro Asp Ile Pro Ser Tyr Gly Ser Trp Asp  
 115 120 125  
 Glu Phe Phe Arg Gln Phe Met Lys Gly Gln Glu Ser Gly Cys Trp Asn  
 130 135 140  
 Lys Thr Asp Cys  
 145

<210> 9  
 <211> 447  
 <212> DNA  
 <213> homo sapiens

<400> 9  
 atggctgata aatccaaatt tattgaatac attgacgaag ctttagaaaa atcaaaagaa 60  
 actgcactct ctcatttatt ttccacctat caggggattc cttaccccat caccatgtgc 120  
 acctcagaaa ctttccaagc gctggacacc ttcgaagcca gacatgatga catcgtgcta 180  
 gcatcttata caaagtgcgg ttcaaaactgg attctccaca ttgtcagtga attaatatat 240  
 gctgtttcta aaaaaaagta taaatatcca gaattcccag ttcttgaatg tggggattca 300  
 gaaaaaatatc agagaatgaa aggctttcca tcaccaagga ttttggcaac tcacctccac 360  
 tatgacaaat tacctgggtc tatcttcgag aataaagcca agagacagca tctcactatg 420  
 ttgccaggc tggctctcgaa ctctga 447

<210> 10  
 <211> 148  
 <212> PRT  
 <213> homo sapiens

<400> 10  
 Met Ala Asp Lys Ser Lys Phe Ile Glu Tyr Ile Asp Glu Ala Leu Glu  
 1 5 10 15  
 Lys Ser Lys Glu Thr Ala Leu Ser His Leu Phe Phe Thr Tyr Gln Gly  
 20 25 30  
 Ile Pro Tyr Pro Ile Thr Met Cys Thr Ser Glu Thr Phe Gln Ala Leu  
 35 40 45  
 Asp Thr Phe Glu Ala Arg His Asp Asp Ile Val Leu Ala Ser Tyr Pro  
 50 55 60  
 Lys Cys Gly Ser Asn Trp Ile Leu His Ile Val Ser Glu Leu Ile Tyr  
 65 70 75 80  
 Ala Val Ser Lys Lys Lys Tyr Lys Tyr Pro Glu Phe Pro Val Leu Glu  
 85 90 95  
 Cys Gly Asp Ser Glu Lys Tyr Gln Arg Met Lys Gly Phe Pro Ser Pro  
 100 105 110  
 Arg Ile Leu Ala Thr His Leu His Tyr Asp Lys Leu Pro Gly Ser Ile  
 115 120 125  
 Phe Glu Asn Lys Ala Lys Arg Gln His Leu Thr Met Leu Pro Arg Leu  
 130 135 140  
 Val Ser Asn Ser  
 145

<210> 11  
 <211> 561  
 <212> DNA

<213> homo sapiens

<400> 11

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atggctgata aatccaaatt tattgaatac attgacgaag ctttagaaaa atcaaaaagaa 60
actgcactct ctcatattatt ttccacctat caggggattc cttaccccat caccatgtgc 120
acctcagaaa ctttccaagc gctggacacc ttcgaagcca gacatgatga catcgtgcta 180
gcatcttata caaagtgcgg ttcaaactgg attctccaca ttgtcagtga attaatatat 240
gctgtttcta aaaaaaagta taaatatcca gaattcccag ttcttgaatg tggggattca 300
gaaaaatatc agagaatgaa aggcctttcca tcaccaagga ttttggcaac tcacctccac 360
tatgacaaat tacctgggct tatcttcgag aataaagcca agatattggt gatatttcga 420
aacctaaag atacagcagt atcttttttg catttccaca acgatgtccc cgatattcca 480
agctatggct cttgggatga attcttcaga cagttcatga aaggacaaga atctggctgc 540
tggaataaaa cagattgctg a 561
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<210> 12

<211> 186

<212> PRT

<213> homo sapiens

<400> 12

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Met Ala Asp Lys Ser Lys Phe Ile Glu Tyr Ile Asp Glu Ala Leu Glu
1 5 10 15
Lys Ser Lys Glu Thr Ala Leu Ser His Leu Phe Phe Thr Tyr Gln Gly
20 25 30
Ile Pro Tyr Pro Ile Thr Met Cys Thr Ser Glu Thr Phe Gln Ala Leu
35 40 45
Asp Thr Phe Glu Ala Arg His Asp Asp Ile Val Leu Ala Ser Tyr Pro
50 55 60
Lys Cys Gly Ser Asn Trp Ile Leu His Ile Val Ser Glu Leu Ile Tyr
65 70 75 80
Ala Val Ser Lys Lys Lys Tyr Lys Tyr Pro Glu Phe Pro Val Leu Glu
85 90 95
Cys Gly Asp Ser Glu Lys Tyr Gln Arg Met Lys Gly Phe Pro Ser Pro
100 105 110
Arg Ile Leu Ala Thr His Leu His Tyr Asp Lys Leu Pro Gly Ser Ile
115 120 125
Phe Glu Asn Lys Ala Lys Ile Leu Val Ile Phe Arg Asn Pro Lys Asp
130 135 140
Thr Ala Val Ser Phe Leu His Phe His Asn Asp Val Pro Asp Ile Pro
145 150 155 160
Ser Tyr Gly Ser Trp Asp Glu Phe Phe Arg Gln Phe Met Lys Gly Gln
165 170 175
Glu Ser Gly Cys Trp Asn Lys Thr Asp Cys
180 185
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<210> 13

<211> 180

<212> DNA

<213> homo sapiens

<400> 13

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atgcacacac gtgcacattt tcaccttttt gtgtatatatt ttaagagaat gaaaggcttt 60
ccatcaccaa ggattttggc aactcacctc cactatgaca aattacctgg gtctatcttc 120
gagaataaag ccaagagaca gcatctcact atgttgccca ggctggtctc gaactcctga 180
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<210> 14  
 <211> 59  
 <212> PRT  
 <213> homo sapiens

<400> 14  
 Met His Thr Arg Ala His Phe His Leu Phe Val Tyr Ile Phe Lys Arg  
 1 5 10 15  
 Met Lys Gly Phe Pro Ser Pro Arg Ile Leu Ala Thr His Leu His Tyr  
 20 25 30  
 Asp Lys Leu Pro Gly Ser Ile Phe Glu Asn Lys Ala Lys Arg Gln His  
 35 40 45  
 Leu Thr Met Leu Pro Arg Leu Val Ser Asn Ser  
 50 55

<210> 15  
 <211> 645  
 <212> DNA  
 <213> homo sapiens

<400> 15  
 atgcacacac gtgcacattt tcaccttttt gtgtatatatt ttaagagaat gaaaggcttt 60  
 ccatcaccaa ggattttggc aactcacctc cactatgaca aattacctgg gtctatcttc 120  
 gagaataaag ccaagatatt ggtgatattt cgaaacccta aagatacagc agtatctttt 180  
 ttgcatttcc acaacgatgt ccccgatatt ccaagctatg gctcttggga tgaattcttc 240  
 agacagttca tgaaaggaca agtttcttgg ggaaggtatt ttgattttgc aatcaattgg 300  
 aacaaacatc ttgatggcga caatgttaag ttcattattat atgaagacct gaaagagaat 360  
 ctggctgctg gaataaaaca gattgctgag ttcttgggat tctttctaac tggggagcaa 420  
 attcaaacta tctcagtcca gagcaccttc caagccatgc gtgcgaagtc tcaggacaca 480  
 cacggtgctg tcggcccatt cttttccgc aaaggtgaag ttggtgattg gaaaaatttg 540  
 ttcagtgaat ttcagaacca ggaaatggat gaaaaattca aagagtgcctt agcaggcacc 600  
 tccctcggag caaagttgaa gtatgaatca tattgccagg gttga 645

<210> 16  
 <211> 214  
 <212> PRT  
 <213> homo sapiens

<400> 16  
 Met His Thr Arg Ala His Phe His Leu Phe Val Tyr Ile Phe Lys Arg  
 1 5 10 15  
 Met Lys Gly Phe Pro Ser Pro Arg Ile Leu Ala Thr His Leu His Tyr  
 20 25 30  
 Asp Lys Leu Pro Gly Ser Ile Phe Glu Asn Lys Ala Lys Ile Leu Val  
 35 40 45  
 Ile Phe Arg Asn Pro Lys Asp Thr Ala Val Ser Phe Leu His Phe His  
 50 55 60  
 Asn Asp Val Pro Asp Ile Pro Ser Tyr Gly Ser Trp Asp Glu Phe Phe  
 65 70 75 80  
 Arg Gln Phe Met Lys Gly Gln Val Ser Trp Gly Arg Tyr Phe Asp Phe  
 85 90 95  
 Ala Ile Asn Trp Asn Lys His Leu Asp Gly Asp Asn Val Lys Phe Ile  
 100 105 110  
 Leu Tyr Glu Asp Leu Lys Glu Asn Leu Ala Ala Gly Ile Lys Gln Ile  
 115 120 125

Ala Glu Phe Leu Gly Phe Phe Leu Thr Gly Glu Gln Ile Gln Thr Ile  
 130 135 140  
 Ser Val Gln Ser Thr Phe Gln Ala Met Arg Ala Lys Ser Gln Asp Thr  
 145 150 155 160  
 His Gly Ala Val Gly Pro Phe Leu Phe Arg Lys Gly Glu Val Gly Asp  
 165 170 175  
 Trp Lys Asn Leu Phe Ser Glu Ile Gln Asn Gln Glu Met Asp Glu Lys  
 180 185 190  
 Phe Lys Glu Cys Leu Ala Gly Thr Ser Leu Gly Ala Lys Leu Lys Tyr  
 195 200 205  
 Glu Ser Tyr Cys Gln Gly  
 210

<210> 17  
 <211> 294  
 <212> DNA  
 <213> homo sapiens

<400> 17  
 atgcacacac gtgcacattt tcaccttttt gtgtatatatt ttaagagaat gaaaggcttt 60  
 ccatcaccaa ggattttggc aactcacctc cactatgaca aattacctgg gtctatcttc 120  
 gagaataaag ccaagatatt ggtgatattt cgaaacccta aagatacagc agtatctttt 180  
 ttgcatttcc acaacgatgt ccccgatatt ccaagctatg gctcttgga tgaattcttc 240  
 agacagttca tgaaaggaca agaactctggc tgctggaata aaacagattg ctga 294

<210> 18  
 <211> 97  
 <212> PRT  
 <213> homo sapiens

---

<400> 18  
 Met His Thr Arg Ala His Phe His Leu Phe Val Tyr Ile Phe Lys Arg  
 1 5 10 15  
 Met Lys Gly Phe Pro Ser Pro Arg Ile Leu Ala Thr His Leu His Tyr  
 20 25 30  
 Asp Lys Leu Pro Gly Ser Ile Phe Glu Asn Lys Ala Lys Ile Leu Val  
 35 40 45  
 Ile Phe Arg Asn Pro Lys Asp Thr Ala Val Ser Phe Leu His Phe His  
 50 55 60  
 Asn Asp Val Pro Asp Ile Pro Ser Tyr Gly Ser Trp Asp Glu Phe Phe  
 65 70 75 80  
 Arg Gln Phe Met Lys Gly Gln Glu Ser Gly Cys Trp Asn Lys Thr Asp  
 85 90 95  
 Cys

<210> 19  
 <211> 2153  
 <212> DNA  
 <213> homo sapiens

<400> 19  
 ggagaaaagca agaggcttac actgccacaca atgcgagttta gtaaaatcag aattcacatt 60  
 taaacccagg aaactgacta cgtgtagcct gttctggggtc gtttttctaa caccctgaaa 120

cttaaagtgt gatagtctca gaggactacc aacataagca tcacctgaaa acttggttaga 180  
aatgaagaac taggccgggc gcggtggctc acgcctataa tcccagcact ttgggaggcc 240  
tagatgggag gatcacgaca tcaggagacc gagaccatcc tggctaacac gtgaaaaatg 300  
ccatggcctt gttttctcata gcaggtaaa aagaaccaa gaattcactg gtactaacia 360  
ttaaacctat gccctctgag atctcattag tgaggagggg gtggatgaga attaaatgat 420  
ttctttttca tgtgactggg aggagccctt tattccagcc cctgcccac tccattaaaa 480  
gcaatcactc cccctgaaca gccacagagc aggttctttt acagggagcc accatggctg 540  
ataaatccaa atttattgaa tacattgacg aagctttaga aaaatcaaaa gaaactgcac 600  
tctctcattt atttttcacc tatcagggga ttctttaccc catcaccatg tgcacctcag 660  
aaactttcca agcgctggac accttcgaag ccagacatga tgacatcgtg cttagatctt 720  
atccaaagtg cgggttcaaac tggattctcc acattgtcag tgaattaata tatgctgttt 780  
ctaaaaaaa gtataaatat ccagaattcc cagtcttga atgtggggat tcagaaaaat 840  
atctagtac agtagtgcta gaaactatca cttagatacc aaacctagga gtgattcaac 900  
acacacacac acatgcacac acgtgcacat ttccacctt ttgtgtatat ttttaagaga 960  
atgaaaggct ttccatcacc aaggattttg gcaactcacc tccactatga caaattacct 1020  
gggtctatct tcgagaataa agccaagaga cagcatctca ctatgttgcc caggctggtc 1080  
tcgaactcct gacttcaaga gatccttctg ccaccaaggc ctcccaaagt gatattgggtg 1140  
atatttcgaa accctaaga tacagcagta tcttttttgc atttccacaa cgatgtcccc 1200  
gatattccaa gctatggctc ttgggatgaa ttcttcagac agttcatgaa aggacaagtt 1260  
tcttggggaa ggtattttga ttttgcaatc aattggaaca aacatcttga tggcgacaat 1320  
gttaagtcca tattatatga agacctgaaa gagaatctgg ctgctggaat aaaacagatt 1380  
gctgagttct tgggattctt tctaactggg gagcaaattc aaactatctc agtccagagc 1440  
accttccaag ccattgcgtgc gaagtctcag gacacacacg gtgctgtcgg cccattcctt 1500  
ttccgcaaag gtgaagttgg tgattggaaa aatttgttca gtgaaattca gaaccaggaa 1560  
atggatgaaa aattcaaaga gtgcttagca ggcacctccc tcggagcaaa gttgaagtat 1620  
gaatcatatt gccagggttg attccagtca attcagcagg cctagattta ttttccttaa 1680  
taataattaa gtgtaataaa ttaaatgata attcaatcaa ataataaat aataattaaa 1740  
caatattgaa atctaataa tacaatacaa aataataata caatttaata ataatgataa 1800  
catcggacat ttttgagcac aaatataagt ttgttactt tttcaagaaa ggatatttca 1860  
gcagtcccaa agggacacta ttattaatac atcacactgg agttttaact tattttgtgc 1920  
tctaggttca cgtaagaggg taaggagata ctatcagaga catacctaaa gctgtgtttg 1980  
gcatagatg acacaggcct ccaaattgtg cacaatttct tgtactttgc tcgtaataa 2040  
actcctttct tactatggat aaaagcactt ggggtggcta tctcagacaa tgttggggga 2100  
gagttaattc caactctgca ataaattcca ttctaatttg gttcaggaaa aaa 2153

&lt;210&gt; 20

&lt;211&gt; 432

&lt;212&gt; DNA

&lt;213&gt; homo sapiens

&lt;400&gt; 20

atgaccgatg ctgagagagt ggatcaggca taccgagaaa atggatttaa catctacgtc 60  
agtataaaa tctccttgaa tcgctctctc ccagatatcc ggcacccaaa ctgcaacagc 120  
aagcgctacc tggagacact tcccaacaca agcatcatca tccccttcca caacgagggc 180  
tggctcctcc tctccgcac cgtccacagt gtgctcaatc gctcgcctcc agagctgggtc 240  
gccgagattg tactggctga cgacttcagt gatcgaggta ggatccgtcc caccagcct 300  
cccaccctct gtgcttcac tggcgactca ccaaaggat ggcaggtttt cccttcttta 360  
gcagcatcaa catataggcc atcattggct aaatgcctgg acgttgact gtgcacacat 420  
tttctcattt aa 432

&lt;210&gt; 21

&lt;211&gt; 143

&lt;212&gt; PRT

&lt;213&gt; homo sapiens

&lt;400&gt; 21

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Met Thr Asp Ala Glu Arg Val Asp Gln Ala Tyr Arg Glu Asn Gly Phe
 1           5           10          15
Asn Ile Tyr Val Ser Asp Lys Ile Ser Leu Asn Arg Ser Leu Pro Asp
 20          25          30
Ile Arg His Pro Asn Cys Asn Ser Lys Arg Tyr Leu Glu Thr Leu Pro
 35          40          45
Asn Thr Ser Ile Ile Ile Pro Phe His Asn Glu Gly Trp Ser Ser Leu
 50          55          60
Leu Arg Thr Val His Ser Val Leu Asn Arg Ser Pro Pro Glu Leu Val
 65          70          75          80
Ala Glu Ile Val Leu Val Asp Asp Phe Ser Asp Arg Gly Arg Ile Arg
 85          90          95
Pro Thr Gln Pro Pro Thr Leu Cys Ala Ser Ser Gly Asp Ser Pro Lys
100          105          110
Gly Trp Gln Val Phe Pro Ser Leu Ala Ala Ser Thr Tyr Arg Pro Ser
115          120          125
Leu Ala Lys Cys Leu Asp Val Ala Leu Cys Thr His Phe Leu Ile
130          135          140

```

&lt;210&gt; 22

&lt;211&gt; 675

&lt;212&gt; DNA

&lt;213&gt; homo sapiens

&lt;400&gt; 22

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atgaccgatg ctgagagagt ggatcaggca taccgagaaa atggatttaa catctacgtc 60
agtataaaaa tctccttgaa tcgctctctc ccagatatcc ggcacccaaa ctgcaacagc 120
aagcgctacc tggagacact tcccaacaca agcatcatca tccccttcca caacgagggc 180
tggctctccc tctccgcac cgtccacagt gtgctcaatc gctcgctcc agagctggc 240
gccgagattg tactggtcga cgacttcagt gatcagagc acctgaagaa gcctctgaa 300
gactacatgg cccttttccc cagtgtgagg attcttcgaa ccaagaaacg ggaagggctg 360
ataaggaccc gaatgctggg ggcctcagtg gcaactggg atgtcatcac attcttggat 420
tcacactgtg aagccaatgt caactggctt ccccccttgc ttggttaagg agccccctcc 480
acttggaggg agggaaactg caatgagcca gtgccagtg cccccctctg ctgcagggag 540
ccatccataa gccttccctt gcctgttcaa gatgccccca gcacaatgcc aggtgccatg 600
agggattcag aagttcagga gtgctcaaaa ttaaaatcca gccagtcctg tcccttcatt 660
tcacagagaa gttaa 675

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&lt;210&gt; 23

&lt;211&gt; 224

&lt;212&gt; PRT

&lt;213&gt; homo sapiens

&lt;400&gt; 23

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Met Thr Asp Ala Glu Arg Val Asp Gln Ala Tyr Arg Glu Asn Gly Phe
 1           5           10          15
Asn Ile Tyr Val Ser Asp Lys Ile Ser Leu Asn Arg Ser Leu Pro Asp
 20          25          30
Ile Arg His Pro Asn Cys Asn Ser Lys Arg Tyr Leu Glu Thr Leu Pro
 35          40          45
Asn Thr Ser Ile Ile Ile Pro Phe His Asn Glu Gly Trp Ser Ser Leu
 50          55          60
Leu Arg Thr Val His Ser Val Leu Asn Arg Ser Pro Pro Glu Leu Val
 65          70          75          80
Ala Glu Ile Val Leu Val Asp Asp Phe Ser Asp Arg Glu His Leu Lys

```

```

      85              90              95
Lys Pro Leu Glu Asp Tyr Met Ala Leu Phe Pro Ser Val Arg Ile Leu
      100              105              110
Arg Thr Lys Lys Arg Glu Gly Leu Ile Arg Thr Arg Met Leu Gly Ala
      115              120              125
Ser Val Ala Thr Gly Asp Val Ile Thr Phe Leu Asp Ser His Cys Glu
      130              135              140
Ala Asn Val Asn Trp Leu Pro Pro Leu Leu Gly Lys Gly Ala Pro Pro
      145              150              155              160
Thr Trp Arg Glu Ala Asn Cys Asn Glu Pro Val Pro Val Ala Pro Ser
      165              170              175
Cys Cys Arg Glu Pro Ser Ile Ser Leu Pro Leu Pro Val Gln Asp Ala
      180              185              190
Pro Ser Thr Met Pro Gly Ala Met Arg Asp Ser Glu Val Gln Glu Cys
      195              200              205
Ser Lys Leu Lys Ser Ser Gln Ser Cys Pro Phe Ile Ser Gln Arg Ser
      210              215              220

```

&lt;210&gt; 24

&lt;211&gt; 339

&lt;212&gt; DNA

&lt;213&gt; homo sapiens

&lt;400&gt; 24

```

atgaccgatg ctgagagagt ggatcaggca taccgagaaa atggatttaa catctacgtc 60
agtgataaaa tctccttgaa tcgctctctc ccagatatcc ggcacccaaa ctgcaacagc 120
aagcgctacc tggagacact tcccaacaca agcatcatca tccccttcca caacgagggc 180
tggctctccc tctccgcac cgtccacagt gtgtcaatc gctcgctcc agagctggtc 240
gccgagattg tactgggtcg cgacttcagt gatcgaggca tctcttggtc tcttcagacc 300
gcattgctcg gaaccgcaag accattgtgt gcccgatga 339

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&lt;210&gt; 25

&lt;211&gt; 112

&lt;212&gt; PRT

&lt;213&gt; homo sapiens

&lt;400&gt; 25

```

Met Thr Asp Ala Glu Arg Val Asp Gln Ala Tyr Arg Glu Asn Gly Phe
 1              5              10              15
Asn Ile Tyr Val Ser Asp Lys Ile Ser Leu Asn Arg Ser Leu Pro Asp
      20              25              30
Ile Arg His Pro Asn Cys Asn Ser Lys Arg Tyr Leu Glu Thr Leu Pro
      35              40              45
Asn Thr Ser Ile Ile Ile Pro Phe His Asn Glu Gly Trp Ser Ser Leu
      50              55              60
Leu Arg Thr Val His Ser Val Leu Asn Arg Ser Pro Pro Glu Leu Val
      65              70              75              80
Ala Glu Ile Val Leu Val Asp Asp Phe Ser Asp Arg Gly Ile Ser Trp
      85              90              95
Leu Leu Gln Thr Ala Leu Leu Gly Thr Ala Arg Pro Leu Cys Ala Arg
      100              105              110

```

&lt;210&gt; 26

&lt;211&gt; 810

&lt;212&gt; DNA

&lt;213&gt; homo sapiens

&lt;400&gt; 26

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atgaccgatg ctgagagagt ggatcaggca taccgagaaa atggatttaa catctacgtc 60
agtataaaaa tctccttgaa tcgctctctc ccagatatcc ggcacccaaa ctgcaacagc 120
aagcgctacc tggagacact tcccaacaca agcatcatca tccccttcca caacgagggc 180
tggtcctccc tcctccgcac cgtccacagt gtgctcaatc gctcgctcc agagctggtc 240
gccgagattg tactggtcga cgacttcagt gatcgagagc acctgaagaa gcctcttgaa 300
gactacatgg cccttttccc cagtgtgagg attcttcgaa ccaagaaacg ggaagggtg 360
ataaggaccc gaatgctggg ggctcagtg gcaactgggg atgtcatcac attcttgat 420
tcacactgtg aagccaatgt caactggctt ccccccctgc ttgaccgcat tgctcggaac 480
cgcaagacca ttgtgtgccc gatgattgat gtaattgacc atgacgactt tcggtacgag 540
acacaggcag gggatgccat gcggggagcc ttgactggg agatgtacta caagcggatc 600
ccgatccctc cagaactgca gaaagctgac cccagcgacc catttgagtc tcccgatgag 660
gccggtggac tggtcgccgt ggatcggaag tggttctggg aactcggcgg gtatgacca 720
ggcttgagaa tctggggagg ggagcagtat gaaatctcct tcaaggtagg ccagctctcc 780
agacgccccg ttcttggcac agcctcctga
810

```

&lt;210&gt; 27

&lt;211&gt; 269

&lt;212&gt; PRT

&lt;213&gt; homo sapiens

&lt;400&gt; 27

```

Met Thr Asp Ala Glu Arg Val Asp Gln Ala Tyr Arg Glu Asn Gly Phe
 1           5           10          15
Asn Ile Tyr Val Ser Asp Lys Ile Ser Leu Asn Arg Ser Leu Pro Asp
 20          25          30
Ile Arg His Pro Asn Cys Asn Ser Lys Arg Tyr Leu Glu Thr Leu Pro
 35          40          45
Asn Thr Ser Ile Ile Ile Pro Phe His Asn Glu Gly Trp Ser Ser Leu
 50          55          60
Leu Arg Thr Val His Ser Val Leu Asn Arg Ser Pro Pro Glu Leu Val
 65          70          75          80
Ala Glu Ile Val Leu Val Asp Asp Phe Ser Asp Arg Glu His Leu Lys
 85          90          95
Lys Pro Leu Glu Asp Tyr Met Ala Leu Phe Pro Ser Val Arg Ile Leu
100         105         110
Arg Thr Lys Lys Arg Glu Gly Leu Ile Arg Thr Arg Met Leu Gly Ala
115         120         125
Ser Val Ala Thr Gly Asp Val Ile Thr Phe Leu Asp Ser His Cys Glu
130         135         140
Ala Asn Val Asn Trp Leu Pro Pro Leu Leu Asp Arg Ile Ala Arg Asn
145         150         155         160
Arg Lys Thr Ile Val Cys Pro Met Ile Asp Val Ile Asp His Asp Asp
165         170         175
Phe Arg Tyr Glu Thr Gln Ala Gly Asp Ala Met Arg Gly Ala Phe Asp
180         185         190
Trp Glu Met Tyr Tyr Lys Arg Ile Pro Ile Pro Pro Glu Leu Gln Lys
195         200         205
Ala Asp Pro Ser Asp Pro Phe Glu Ser Pro Val Met Ala Gly Gly Leu
210         215         220
Phe Ala Val Asp Arg Lys Trp Phe Trp Glu Leu Gly Gly Tyr Asp Pro
225         230         235         240
Gly Leu Glu Ile Trp Gly Gly Glu Gln Tyr Glu Ile Ser Phe Lys Val

```

245 250 255  
 Ser Gln Leu Ser Arg Arg Pro Val Leu Gly Thr Ala Ser  
 260 265

<210> 28  
 <211> 1608  
 <212> DNA  
 <213> homo sapiens

<400> 28  
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 aagcgctacc tggagacact tccaacacac agcatcatca tccccttcca caacgagggc 180  
 tggctcctccc tctccgcac cgtccacagt gtgctcaatc gctcgccctc agagctgggc 240  
 gccgagattg tactggctga cgacttcagt gatcgagagc acctgaagaa gcctcttgaa 300  
 gactacatgg cccttttccc cagtgtgagg attcttcgaa ccaagaaacg ggaagggctg 360  
 ataaggaccc gaatgctggg ggcctcagt gcaactgggg atgtcatcac attcttggtat 420  
 tcacactgtg aagccaatgt caactggcct ccccccctgc ttgaccgat tgctcggaac 480  
 cgcaagacca ttgtgtgccc gatgattgat gtaattgacc atgacgactt tcggtacgag 540  
 acacaggcag gggatgccat gcggggagcc tttgactggg agatgtacta caagcggatc 600  
 ccgatccctc cagaactgca gaaagctgac cccagcgacc catttgagtc tcccgtgatg 660  
 gccggtggac tgttcgccgt ggatcggaag tggttctggg aactcggcgg gtatgaccca 720  
 ggcttgaga tctggggagg ggagcagtat gaaatctcct tcaagggtct ccatatgttg 780  
 cccaggctgg tctcaaatc ctggcctcaa gcagtcttc tgccctcggg tccaacatg 840  
 ctggcattac aggtgtgat gtgtgggggc cgcattggag acatcccctg ctccagggtg 900  
 ggccatatct acaggaagta tgtgccctac aaggtcccgg ccggagtcag cctggcccgg 960  
 aaccttaagc ggttgccga agtgtggtg gatgagtacg cagagtacat ttaccagcgc 1020  
 cggcctgaat accgccacct ctccgtggg gatgtcgag tccagaaaaa gctccgcagc 1080  
 tcccttaact gcaagagttt caagtggttt atgacgaaga tagcctggga cctgcccaca 1140  
 ttctaccac ccgtggagcc cccggctgca gcttggggg agatccgaaa tgtgggcaca 1200  
 gggctgtgtg cagacacaaa gcacggggcc ttgggctccc cactaaggct agagggctgc 1260  
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 cacaccagcc ctgtcacgct gtacgactgc cacagcatga agggcaacca gctgtgaaa 1440  
 taccgcaag acaagaccct gtaccacct gtcagtggca gctgcatgga ctgcagtga 1500  
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<210> 29  
 <211> 535  
 <212> PRT  
 <213> homo sapiens

<400> 29  
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 1 5 10 15  
 Asn Ile Tyr Val Ser Asp Lys Ile Ser Leu Asn Arg Ser Leu Pro Asp  
 20 25 30  
 Ile Arg His Pro Asn Cys Asn Ser Lys Arg Tyr Leu Glu Thr Leu Pro  
 35 40 45  
 Asn Thr Ser Ile Ile Ile Pro Phe His Asn Glu Gly Trp Ser Ser Leu  
 50 55 60  
 Leu Arg Thr Val His Ser Val Leu Asn Arg Ser Pro Pro Glu Leu Val  
 65 70 75 80  
 Ala Glu Ile Val Leu Val Asp Asp Phe Ser Asp Arg Glu His Leu Lys

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530

535

<210> 30  
 <211> 1521  
 <212> DNA  
 <213> homo sapiens

&lt;400&gt; 30

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agtataaaaa tctccttgaa tcgctctctc ccagatatcc ggcacccaaa ctgcaacagc 120
aagcgctacc tggagacact tccaacaca agcatcatca tccccttcca caacgagggc 180
tggctcctccc tcctccgcac cgtccacagt gtgctcaatc gctcgctccc agagctggtc 240
gccgagattg tactggctga cgacttcagt gatcgagagc acctgaagaa gcctcttgaa 300
gactacatgg cccttttccc cagtgtgagg attcttcgaa ccaagaaacg ggaagggctg 360
ataaggaccc gaatgtgagg ggcctcagtg gcaactgggg atgtcatcac attcttggtg 420
tcacactgtg aagccaatgt caactggctt ccccccttgc ttgaccgcat tgctcggaac 480
cgcaagacca ttgtgtgccc gatgattgat gtaattgacc atgacgactt tcggtacgag 540
acacaggcag gggatgccat gcggggagcc ttgtactggg agatgtacta caagcggatc 600
ccgatccctc cagaactgca gaaagctgac ccagcgcacc catttgagtc tcccgtgatg 660
gccggtggac tgttcgccgt ggatcggaag tggttctggg aactcggcgg gtatgacca 720
ggcttggaga tctggggagg ggagcagtat gaaatctcct tcaagggtgtg gatgtgtggg 780
ggccgcatgg aggacatccc ctgctccagg gtgggccata tctacaggaa gtatgtgccc 840
tacaaggtcc cggccggagt cagcctggcc cggaacctta agcgggtggc cgaagtgtgg 900
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tttatgacga agatagcctg ggacctgccc aaattctacc caccctgtga gccccggct 1080
gcagcttggg gggagatccg aaatgtgggc acagggctgt gtgcagacac aaagcacggg 1140
gccttgggct cccactaag gctagagggc tgcgtccgag gccgtgggga ggctgcctgg 1200
aacaacatgc aggtattcac ctacacctgg agagaggaca tccggcctgg agacccccag 1260
cacaccaaga agttctgctt tgatgccatt tcccacacca gccctgtcac gctgtacgac 1320
tgccacagca tgaagggcaa ccagctgtgg aaataccgca aagacaagac cctgtaccac 1380
cctgtcagtg gcagctgcat ggactgcagt gaaagtgacc ataggatctt catgaacacc 1440
tgcaacccat cctctctcac ccagcagtggt ctgtttgaac acaccaactc aacagtcttg 1500
gaaaaattca ataggaactg a
1521

```

<210> 31  
 <211> 506  
 <212> PRT  
 <213> homo sapiens

&lt;400&gt; 31

```

Met Thr Asp Ala Glu Arg Val Asp Gln Ala Tyr Arg Glu Asn Gly Phe
 1           5           10           15
Asn Ile Tyr Val Ser Asp Lys Ile Ser Leu Asn Arg Ser Leu Pro Asp
 20           25           30
Ile Arg His Pro Asn Cys Asn Ser Lys Arg Tyr Leu Glu Thr Leu Pro
 35           40           45
Asn Thr Ser Ile Ile Ile Pro Phe His Asn Glu Gly Trp Ser Ser Leu
 50           55           60
Leu Arg Thr Val His Ser Val Leu Asn Arg Ser Pro Pro Glu Leu Val
 65           70           75           80
Ala Glu Ile Val Leu Val Asp Asp Phe Ser Asp Arg Glu His Leu Lys
 85           90           95
Lys Pro Leu Glu Asp Tyr Met Ala Leu Phe Pro Ser Val Arg Ile Leu
100           105           110

```

Arg Thr Lys Lys Arg Glu Gly Leu Ile Arg Thr Arg Met Leu Gly Ala  
 115 120 125  
 Ser Val Ala Thr Gly Asp Val Ile Thr Phe Leu Asp Ser His Cys Glu  
 130 135 140  
 Ala Asn Val Asn Trp Leu Pro Pro Leu Leu Asp Arg Ile Ala Arg Asn  
 145 150 155 160  
 Arg Lys Thr Ile Val Cys Pro Met Ile Asp Val Ile Asp His Asp Asp  
 165 170 175  
 Phe Arg Tyr Glu Thr Gln Ala Gly Asp Ala Met Arg Gly Ala Phe Asp  
 180 185 190  
 Trp Glu Met Tyr Tyr Lys Arg Ile Pro Ile Pro Pro Glu Leu Gln Lys  
 195 200 205  
 Ala Asp Pro Ser Asp Pro Phe Glu Ser Pro Val Met Ala Gly Gly Leu  
 210 215 220  
 Phe Ala Val Asp Arg Lys Trp Phe Trp Glu Leu Gly Gly Tyr Asp Pro  
 225 230 235 240  
 Gly Leu Glu Ile Trp Gly Gly Glu Gln Tyr Glu Ile Ser Phe Lys Val  
 245 250 255  
 Trp Met Cys Gly Gly Arg Met Glu Asp Ile Pro Cys Ser Arg Val Gly  
 260 265 270  
 His Ile Tyr Arg Lys Tyr Val Pro Tyr Lys Val Pro Ala Gly Val Ser  
 275 280 285  
 Leu Ala Arg Asn Leu Lys Arg Val Ala Glu Val Trp Met Asp Glu Tyr  
 290 295 300  
 Ala Glu Tyr Ile Tyr Gln Arg Arg Pro Glu Tyr Arg His Leu Ser Ala  
 305 310 315 320  
 Gly Asp Val Ala Val Gln Lys Lys Leu Arg Ser Ser Leu Asn Cys Lys  
 325 330 335  
 Ser Phe Lys Trp Phe Met Thr Lys Ile Ala Trp Asp Leu Pro Lys Phe  
 340 345 350  
 Tyr Pro Pro Val Glu Pro Pro Ala Ala Trp Gly Glu Ile Arg Asn  
 355 360 365  
 Val Gly Thr Gly Leu Cys Ala Asp Thr Lys His Gly Ala Leu Gly Ser  
 370 375 380  
 Pro Leu Arg Leu Glu Gly Cys Val Arg Gly Arg Gly Glu Ala Ala Trp  
 385 390 395 400  
 Asn Asn Met Gln Val Phe Thr Phe Thr Trp Arg Glu Asp Ile Arg Pro  
 405 410 415  
 Gly Asp Pro Gln His Thr Lys Lys Phe Cys Phe Asp Ala Ile Ser His  
 420 425 430  
 Thr Ser Pro Val Thr Leu Tyr Asp Cys His Ser Met Lys Gly Asn Gln  
 435 440 445  
 Leu Trp Lys Tyr Arg Lys Asp Lys Thr Leu Tyr His Pro Val Ser Gly  
 450 455 460  
 Ser Cys Met Asp Cys Ser Glu Ser Asp His Arg Ile Phe Met Asn Thr  
 465 470 475 480  
 Cys Asn Pro Ser Ser Leu Thr Gln Gln Trp Leu Phe Glu His Thr Asn  
 485 490 495  
 Ser Thr Val Leu Glu Lys Phe Asn Arg Asn  
 500 505

&lt;210&gt; 32

&lt;211&gt; 723

&lt;212&gt; DNA

&lt;213&gt; homo sapiens

&lt;400&gt; 32

```

atgaggcgga aggagaagcg gctcctgcag gcggtggcgc tgggtgctggc ggccctggtc 60
ctcctgcccac agtggggct ttgggcgctg taccgcgagc ggcagcccga cggcaccctc 120
gggggatcgg gggcgcggt ggcgcggcg gcgggacagg gctcacacag tcgacaaaag 180
aaaacgtttt tcttgggaga tgggcagaag ctgaaggact ggcattgacaa ggaggccatc 240
cggaggggacg ctcagcgcg aggaatgga gaacaaggaa gaccttacct catgaccgat 300
gctgagagag tggatcaggc ataccgagaa aatggattta acatctacgt cagtataaaa 360
atctccttga atcgctctct cccagatata cggcacccaa actgcaacag caagcgctac 420
ctggagacac ttccaacac aagcatcatc atccccctcc acaacgaggg ctggtcctcc 480
ctcctccgca ccgtccacag tgtgtcaat cgctgcctc cagagctggt cgccgagatt 540
gtactggctg acgacttcag tgatcgaggt aggatccgct ccaccagcc tcccaccctc 600
tgtgttcat ctggcgactc accaaaggga tggcaggttt tcccttcttt agcagcatca 660
acatataggc catcattggc taaatgcctg gacgttgac tgtgcacaca ttttctcatt 720
taa

```

&lt;210&gt; 33

&lt;211&gt; 240

&lt;212&gt; PRT

&lt;213&gt; homo sapiens

&lt;400&gt; 33

```

Met Arg Arg Lys Glu Lys Arg Leu Leu Gln Ala Val Ala Leu Val Leu
1      5      10     15
Ala Ala Leu Val Leu Leu Pro Asn Val Gly Leu Trp Ala Leu Tyr Arg
20     25     30
Glu Arg Gln Pro Asp Gly Thr Pro Gly Gly Ser Gly Ala Ala Val Ala
35     40     45
Pro Ala Ala Gly Gln Gly Ser His Ser Arg Gln Lys Lys Thr Phe Phe
50     55     60
Leu Gly Asp Gly Gln Lys Leu Lys Asp Trp His Asp Lys Glu Ala Ile
65     70     75     80
Arg Arg Asp Ala Gln Arg Val Gly Asn Gly Glu Gln Gly Arg Pro Tyr
85     90     95
Pro Met Thr Asp Ala Glu Arg Val Asp Gln Ala Tyr Arg Glu Asn Gly
100    105    110
Phe Asn Ile Tyr Val Ser Asp Lys Ile Ser Leu Asn Arg Ser Leu Pro
115    120    125
Asp Ile Arg His Pro Asn Cys Asn Ser Lys Arg Tyr Leu Glu Thr Leu
130    135    140
Pro Asn Thr Ser Ile Ile Ile Pro Phe His Asn Glu Gly Trp Ser Ser
145    150    155    160
Leu Leu Arg Thr Val His Ser Val Leu Asn Arg Ser Pro Pro Glu Leu
165    170    175
Val Ala Glu Ile Val Leu Val Asp Asp Phe Ser Asp Arg Gly Arg Ile
180    185    190
Arg Pro Thr Gln Pro Pro Thr Leu Cys Ala Ser Ser Gly Asp Ser Pro
195    200    205
Lys Gly Trp Gln Val Phe Pro Ser Leu Ala Ala Ser Thr Tyr Arg Pro
210    215    220
Ser Leu Ala Lys Cys Leu Asp Val Ala Leu Cys Thr His Phe Leu Ile
225    230    235    240

```

&lt;210&gt; 34

&lt;211&gt; 966

&lt;212&gt; DNA

&lt;213&gt; homo sapiens

&lt;400&gt; 34

```

atgaggcgga aggagaagcg gctcctgcag gcggtggcgc tgggtgctggc ggccctggtc 60
ctcctgcca acgtggggct ttgggcgctg taccgcgagc ggcagcccga cggcaccct 120
gggggatcgg gggcggcggt ggcgccggcg gcgggacagg gctcacacag tcgacaaaag 180
aaaacgtttt tcttgggaga tgggcagaag ctgaaggact ggcattgaaa ggaggccatc 240
cggaggggacg ctcagcgcgt aggaaatgga gaacaaggaa gaccttacc catgaccgat 300
gctgagagag tggatcaggc ataccgagaa aatggattta acatctacgt cagtataaa 360
atctccttga atcgctctct cccagatatc cggcacccaa actgcaacag caagcgctac 420
ctggagacac ttcccaacac aagcatcatc atccccttcc acaacgagg ctggtcctcc 480
ctcctccgca ccgtccacag tgtgctcaat cgctcgctc cagagctggt cggcgagatt 540
gtactggctg acgacttcag tgatcgagag cacctgaaga agcctcttga agactacatg 600
gcccttttcc ccagtgtgag gattcttcga accaagaaac ggggaagggt gataaggacc 660
cgaatgctgg gggcctcagt ggcaactggg gatgtcatca cattcttga ttcacactgt 720
gaagccaatg tcaactggct tcccccttg cttgtaagg gagccccctc cacttgagg 780
gaggcaaaact gcaatgagcc agtgccagtg gccccctcct gctgcaggga gccatccata 840
agccttcctt tgcctgttca agatgcccc agcacaatgc cagggtgcat gagggattca 900
gaagttcagg agtgctcaaa attaaaatcc agccagtcct gtcccttcat ttcacagaga 960
agttaa

```

&lt;210&gt; 35

&lt;211&gt; 321

&lt;212&gt; PRT

&lt;213&gt; homo sapiens

&lt;400&gt; 35

```

Met Arg Arg Lys Glu Lys Arg Leu Leu Gln Ala Val Ala Leu Val Leu
1      5      10      15
Ala Ala Leu Val Leu Leu Pro Asn Val Gly Leu Trp Ala Leu Tyr Arg
20     25     30
Glu Arg Gln Pro Asp Gly Thr Pro Gly Gly Ser Gly Ala Ala Val Ala
35     40     45
Pro Ala Ala Gly Gln Gly Ser His Ser Arg Gln Lys Lys Thr Phe Phe
50     55     60
Leu Gly Asp Gly Gln Lys Leu Lys Asp Trp His Asp Lys Glu Ala Ile
65     70     75     80
Arg Arg Asp Ala Gln Arg Val Gly Asn Gly Glu Gln Gly Arg Pro Tyr
85     90     95
Pro Met Thr Asp Ala Glu Arg Val Asp Gln Ala Tyr Arg Glu Asn Gly
100    105    110
Phe Asn Ile Tyr Val Ser Asp Lys Ile Ser Leu Asn Arg Ser Leu Pro
115    120    125
Asp Ile Arg His Pro Asn Cys Asn Ser Lys Arg Tyr Leu Glu Thr Leu
130    135    140
Pro Asn Thr Ser Ile Ile Pro Phe His Asn Glu Gly Trp Ser Ser
145    150    155    160
Leu Leu Arg Thr Val His Ser Val Leu Asn Arg Ser Pro Pro Glu Leu
165    170    175
Val Ala Glu Ile Val Leu Val Asp Asp Phe Ser Asp Arg Glu His Leu
180    185    190
Lys Lys Pro Leu Glu Asp Tyr Met Ala Leu Phe Pro Ser Val Arg Ile
195    200    205
Leu Arg Thr Lys Lys Arg Glu Gly Leu Ile Arg Thr Arg Met Leu Gly
210    215    220
Ala Ser Val Ala Thr Gly Asp Val Ile Thr Phe Leu Asp Ser His Cys

```

```

225          230          235          240
Glu Ala Asn Val Asn Trp Leu Pro Pro Leu Leu Gly Lys Gly Ala Pro
          245          250          255
Pro Thr Trp Arg Glu Ala Asn Cys Asn Glu Pro Val Pro Val Ala Pro
          260          265          270
Ser Cys Cys Arg Glu Pro Ser Ile Ser Leu Pro Leu Pro Val Gln Asp
          275          280          285
Ala Pro Ser Thr Met Pro Gly Ala Met Arg Asp Ser Glu Val Gln Glu
          290          295          300
Cys Ser Lys Leu Lys Ser Ser Gln Ser Cys Pro Phe Ile Ser Gln Arg
305          310          315          320
Ser

```

```

<210> 36
<211> 630
<212> DNA
<213> homo sapiens

```

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<400> 36
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ctcctgccca acgtggggct ttgggcgctg taccgcgagc ggcagcccga cggcaccctc 120
gggggatcgg gggcggcggt ggcgcgcgag gcgggacagg gctcacacag tcgacaaaag 180
aaaacgtttt tcttgggaga tgggcagaag ctgaaggact ggcatgacaa ggaggccatc 240
cggagggacg ctcagcgcgt aggaaatgga gaacaaggaa gaccttacct catgaccgat 300
gctgagagag tggatcaggc ataccgagaa aatggattta acatctacgt cagtgataaa 360
atctccttga atcgctctct cccagatata cggcacccaa actgcaacag caagcgctac 420
ctggagacac ttcccaacac aagcatcatc atcccccttc acaacgaggg ctggtcctcc 480
ctcctccgca ccgtccacag tgtgctcaat cgctgcctc cagagctggt cgccgagatt 540
gtactggtcg acgacttcag tgatcgaggc atctcttggc ttcttcagac cgcattgctc 600
ggaaccgcaa gaccattgtg tgcccgatga                                     630

```

```

<210> 37
<211> 209
<212> PRT
<213> homo sapiens

```

```

<400> 37
Met Arg Arg Lys Glu Lys Arg Leu Leu Gln Ala Val Ala Leu Val Leu
 1          5          10          15
Ala Ala Leu Val Leu Leu Pro Asn Val Gly Leu Trp Ala Leu Tyr Arg
          20          25          30
Glu Arg Gln Pro Asp Gly Thr Pro Gly Gly Ser Gly Ala Ala Val Ala
          35          40          45
Pro Ala Ala Gly Gln Gly Ser His Ser Arg Gln Lys Lys Thr Phe Phe
          50          55          60
Leu Gly Asp Gly Gln Lys Leu Lys Asp Trp His Asp Lys Glu Ala Ile
65          70          75          80
Arg Arg Asp Ala Gln Arg Val Gly Asn Gly Glu Gln Gly Arg Pro Tyr
          85          90          95
Pro Met Thr Asp Ala Glu Arg Val Asp Gln Ala Tyr Arg Glu Asn Gly
          100          105          110
Phe Asn Ile Tyr Val Ser Asp Lys Ile Ser Leu Asn Arg Ser Leu Pro
          115          120          125
Asp Ile Arg His Pro Asn Cys Asn Ser Lys Arg Tyr Leu Glu Thr Leu

```

130 135 140  
 Pro Asn Thr Ser Ile Ile Ile Pro Phe His Asn Glu Gly Trp Ser Ser  
 145 150 155 160  
 Leu Leu Arg Thr Val His Ser Val Leu Asn Arg Ser Pro Pro Glu Leu  
 165 170 175  
 Val Ala Glu Ile Val Leu Val Asp Asp Phe Ser Asp Arg Gly Ile Ser  
 180 185 190  
 Trp Leu Leu Gln Thr Ala Leu Leu Gly Thr Ala Arg Pro Leu Cys Ala  
 195 200 205  
 Arg

<210> 38  
 <211> 1101  
 <212> DNA  
 <213> homo sapiens

<400> 38  
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 ctctgcccac acgtggggct ttggggcgctg taccgcgagc ggcagcccga cggcaccct 120  
 gggggatcgg gggcgggcgt ggccggcgcg gcgggacagg gctcacacag tcgacaaaag 180  
 aaaacgtttt tcttgggaga tgggcagaag ctgaaggact ggcatgacaa ggaggccatc 240  
 cggagggacg ctcagcgcggt aggaaatgga gaacaaggaa gaccttacc catgaccgat 300  
 gctgagagag tggatcaggc ataccgagaa aatggattta acatctacgt cagtataaa 360  
 atctccttga atcgctctct cccagatata cggcacccaa actgcaacag caagcgctac 420  
 ctggagacac ttccaacac aagcatcatc atcccccttc acaacgaggg ctggctctcc 480  
 ctctccgca ccgtccacag tgtgtcctaat cgctcgctc cagagctggc cgccgagatt 540  
 gtactggtcg acgacttcag tgatcgagag cacctgaaga agcctcttga agactacatg 600  
 gcccttttcc ccagtgtgag gattcttcga accaagaaac ggggaagggt gataaggacc 660  
 cgaatgctgg gggcctcagt ggcaactggg gatgtcatca cattcttga ttcacactgt 720  
 gaagccaatg tcaactggct tcccccttg cttgaccgca ttgctcgaa ccgcaagacc 780  
 attgtgtgcc cgatgattga tgtaattgac catgacgact ttcggtacga gacacaggca 840  
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 ccagaactgc agaaagctga cccagcgac ccatttgagt ctcccgatg ggcgggtgga 960  
 ctgttcgccg tggatcgaa gtggttctgg gaactcggcg ggtatgacct aggcttgag 1020  
 atctggggag gggagcagta tgaaatctcc ttcaagtgga gccagctctc cagacgcccc 1080  
 gttcttgga cagcctcctg a 1101

<210> 39  
 <211> 366  
 <212> PRT  
 <213> homo sapiens

<400> 39  
 Met Arg Arg Lys Glu Lys Arg Leu Leu Gln Ala Val Ala Leu Val Leu  
 1 5 10 15  
 Ala Ala Leu Val Leu Leu Pro Asn Val Gly Leu Trp Ala Leu Tyr Arg  
 20 25 30  
 Glu Arg Gln Pro Asp Gly Thr Pro Gly Gly Ser Gly Ala Ala Val Ala  
 35 40 45  
 Pro Ala Ala Gly Gln Gly Ser His Ser Arg Gln Lys Lys Thr Phe Phe  
 50 55 60  
 Leu Gly Asp Gly Gln Lys Leu Lys Asp Trp His Asp Lys Glu Ala Ile  
 65 70 75 80  
 Arg Arg Asp Ala Gln Arg Val Gly Asn Gly Glu Gln Gly Arg Pro Tyr



```

attgtgtgcc cgatgattga tgtaattgac catgacgact ttcggtacga gacacaggca 840
ggggatgcc tgcgggggagc ctttgactgg gagatgtact acaagcggat cccgatccct 900
ccagaactgc agaaagctga ccccagcgac ccatttgagt ctcccgtgat ggccgggtgga 960
ctgttcgccc tggatcgga gtggttctgg gaactcggcg ggtatgacct aggcttgag 1020
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cgggtggccc aagtgtggat ggatgagtac gcagagtaca tttaccagcg ccggcctgaa 1320
taccgccacc tctccgctgg ggatgtcgca gtccagaaaa agctccgag ctcccttaac 1380
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gcagacacaa agcacggggc cttgggctcc cactaaggc tagagggctg cgtccgaggc 1560
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cctgtcacgc tgtacgactg ccacagcatg aagggaacc agctgtggaa ataccgcaa 1740
gacaagaccc tgtaccaccc tgtcagtggc agctgcatgg actgcagtga aagtgaccat 1800
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accaactcaa cagtcttgga aaaattcaat aggaactga 1899

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<210> 41  
 <211> 631  
 <212> PRT  
 <213> homo sapiens

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<400> 41
Met Arg Arg Lys Glu Lys Arg Leu Leu Gln Ala Val Ala Leu Val Leu
 1          5          10         15
Ala Ala Leu Val Leu Leu Pro Asn Val Gly Leu Trp Ala Leu Tyr Arg
 20         25         30
Glu Arg Gln Pro Asp Gly Thr Pro Gly Gly Ser Gly Ala Val Ala
 35         40         45
Pro Ala Ala Gly Gln Gly Ser His Ser Arg Gln Lys Lys Thr Phe Phe
 50         55         60
Leu Gly Asp Gly Gln Lys Leu Lys Asp Trp His Asp Lys Glu Ala Ile
 65         70         75         80
Arg Arg Asp Ala Gln Arg Val Gly Asn Gly Glu Gln Gly Arg Pro Tyr
 85         90         95
Pro Met Thr Asp Ala Glu Arg Val Asp Gln Ala Tyr Arg Glu Asn Gly
100        105        110
Phe Asn Ile Tyr Val Ser Asp Lys Ile Ser Leu Asn Arg Ser Leu Pro
115        120        125
Asp Ile Arg His Pro Asn Cys Asn Ser Lys Arg Tyr Leu Glu Thr Leu
130        135        140
Pro Asn Thr Ser Ile Ile Ile Pro Phe His Asn Glu Gly Trp Ser Ser
145        150        155        160
Leu Leu Arg Thr Val His Ser Val Leu Asn Arg Ser Pro Pro Glu Leu
165        170        175
Val Ala Glu Ile Val Leu Val Asp Asp Phe Ser Asp Arg Glu His Leu
180        185        190
Lys Lys Pro Leu Glu Asp Tyr Met Ala Leu Phe Pro Ser Val Arg Ile
195        200        205
Leu Arg Thr Lys Lys Arg Glu Gly Leu Ile Arg Thr Arg Met Leu Gly
210        215        220
Ala Ser Val Ala Thr Gly Asp Val Ile Thr Phe Leu Asp Ser His Cys
225        230        235        240

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<400> 42

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<210> 43

<211> 603

<212> PRT

<213> homo sapiens

<400> 43

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 20          25          30
Glu Arg Gln Pro Asp Gly Thr Pro Gly Gly Ser Gly Ala Ala Val Ala
 35          40          45
Pro Ala Ala Gly Gln Gly Ser His Ser Arg Gln Lys Lys Thr Phe Phe
 50          55          60
Leu Gly Asp Gly Gln Lys Leu Lys Asp Trp His Asp Lys Glu Ala Ile
 65          70          75          80
Arg Arg Asp Ala Gln Arg Val Gly Asn Gly Glu Gln Gly Arg Pro Tyr
 85          90          95
Pro Met Thr Asp Ala Glu Arg Val Asp Gln Ala Tyr Arg Glu Asn Gly
100          105          110
Phe Asn Ile Tyr Val Ser Asp Lys Ile Ser Leu Asn Arg Ser Leu Pro
115          120          125
Asp Ile Arg His Pro Asn Cys Asn Ser Lys Arg Tyr Leu Glu Thr Leu
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130	135	140
Pro Asn Thr Ser Ile Ile Ile Pro Phe His Asn Glu Gly Trp Ser Ser		
145	150	155
Leu Leu Arg Thr Val His Ser Val Leu Asn Arg Ser Pro Pro Glu Leu		160
	165	170
Val Ala Glu Ile Val Leu Val Asp Asp Phe Ser Asp Arg Glu His Leu		175
	180	185
Lys Lys Pro Leu Glu Asp Tyr Met Ala Leu Phe Pro Ser Val Arg Ile		190
	195	200
Leu Arg Thr Lys Lys Arg Glu Gly Leu Ile Arg Thr Arg Met Leu Gly		205
	210	215
Ala Ser Val Ala Thr Gly Asp Val Ile Thr Phe Leu Asp Ser His Cys		220
225	230	235
Glu Ala Asn Val Asn Trp Leu Pro Pro Leu Leu Asp Arg Ile Ala Arg		240
	245	250
Asn Arg Lys Thr Ile Val Cys Pro Met Ile Asp Val Ile Asp His Asp		255
	260	265
Asp Phe Arg Tyr Glu Thr Gln Ala Gly Asp Ala Met Arg Gly Ala Phe		270
	275	280
Asp Trp Glu Met Tyr Tyr Lys Arg Ile Pro Ile Pro Pro Glu Leu Gln		285
	290	295
Lys Ala Asp Pro Ser Asp Pro Phe Glu Ser Pro Val Met Ala Gly Gly		300
305	310	315
Leu Phe Ala Val Asp Arg Lys Trp Phe Trp Glu Leu Gly Gly Tyr Asp		320
	325	330
Pro Gly Leu Glu Ile Trp Gly Gly Glu Gln Tyr Glu Ile Ser Phe Lys		335
	340	345
Val Trp Met Cys Gly Gly Arg Met Glu Asp Ile Pro Cys Ser Arg Val		350
	355	360
Gly His Ile Tyr Arg Lys Tyr Val Pro Tyr Lys Val Pro Ala Gly Val		365
370	375	380
Ser Leu Ala Arg Asn Leu Lys Arg Val Ala Glu Val Trp Met Asp Glu		
385	390	395
Tyr Ala Glu Tyr Ile Tyr Gln Arg Arg Pro Glu Tyr Arg His Leu Ser		400
	405	410
Ala Gly Asp Val Ala Val Gln Lys Lys Leu Arg Ser Ser Leu Asn Cys		415
	420	425
Lys Ser Phe Lys Trp Phe Met Thr Lys Ile Ala Trp Asp Leu Pro Lys		430
	435	440
Phe Tyr Pro Pro Val Glu Pro Pro Ala Ala Ala Trp Gly Glu Ile Arg		445
	450	455
Asn Val Gly Thr Gly Leu Cys Ala Asp Thr Lys His Gly Ala Leu Gly		460
465	470	475
Ser Pro Leu Arg Leu Glu Gly Cys Val Arg Gly Arg Gly Glu Ala Ala		480
	485	490
Trp Asn Asn Met Gln Val Phe Thr Phe Thr Trp Arg Glu Asp Ile Arg		495
	500	505
Pro Gly Asp Pro Gln His Thr Lys Lys Phe Cys Phe Asp Ala Ile Ser		510
	515	520
His Thr Ser Pro Val Thr Leu Tyr Asp Cys His Ser Met Lys Gly Asn		525
	530	535
Gln Leu Trp Lys Tyr Arg Lys Asp Lys Thr Leu Tyr His Pro Val Ser		540
545	550	555
Gly Ser Cys Met Asp Cys Ser Glu Ser Asp His Arg Ile Phe Met Asn		560
	565	570
Thr Cys Asn Pro Ser Ser Leu Thr Gln Gln Trp Leu Phe Glu His Thr		575

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<210> 44  
 <211> 3896  
 <212> DNA  
 <213> homo sapiens

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 <211> 555  
 <212> DNA  
 <213> homo sapiens

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<210> 46  
 <211> 184  
 <212> PRT  
 <213> homo sapiens

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<400> 46
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 20            25            30
Thr His Pro Gly Glu Gly Leu Val Leu Arg Pro Leu Cys Thr Ala Asp
 35            40            45
Leu Asn Arg Gly Phe Phe Lys Val Leu Gly Gln Leu Thr Glu Thr Gly
 50            55            60
Val Val Ser Pro Glu Gln Phe Met Lys Ser Phe Glu His Met Lys Lys
 65            70            75            80
Ser Gly Asp Tyr Tyr Val Thr Val Val Glu Asp Val Thr Leu Gly Gln
 85            90            95

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Ile Val Ala Thr Ala Thr Leu Ile Ile Glu His Lys Phe Ile His Ser  
                   100                  105                  110  
 Cys Ala Lys Arg Gly Arg Val Glu Asp Val Val Val Ser Asp Glu Cys  
           115                  120                  125  
 Arg Gly Lys Gln Leu Gly Lys Leu Leu Leu Ser Thr Leu Thr Leu Leu  
       130                  135                  140  
 Ser Lys Lys Leu Asn Cys Tyr Lys Ile Thr Leu Glu Cys Leu Pro Gln  
 145                  150                  155                  160  
 Asn Val Gly Phe Tyr Lys Lys Val Gly Tyr Thr Val Ser Glu Glu Asn  
                   165                  170                  175  
 Tyr Met Cys Arg Arg Phe Leu Lys  
                   180

&lt;210&gt; 47

&lt;211&gt; 795

&lt;212&gt; DNA

&lt;213&gt; homo sapiens

&lt;400&gt; 47

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